Federal
Engineering, Inc

State of Montana
Telecommunications
Network Project

STATE OF MONTANA
TELECOMMUNICATIONS NETWORK
PROJECT FEASIBILITY ANALYSIS
REPORT AND RECOMMENDATIONS

VOLUME 2

APPENDICES

FEDERAL ENGINEERING, INC.

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STATE OF MONTANA
TELECOMMUNICATIONS NETWORK
PROJECT FEASIBILITY ANALYSIS
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APPENDICES

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Prepared for the Telecommunications Bureau
Information Services Division
Department of Administration
State of Montana

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APPENDIX A

TELECOMMUNICATION POLICY ADVISORY COUNCIL

(TPAC)

TELECOMMUNICATIONS POLICY ADVISORY COUNCIL
Member List

Rep. Joe Quilici
Chairman
3040 Kossuth
Butte, MT 59701

Sen. Dick Manning
Vice Chairman
810 Seventh Ave. No.
Great Falls, MT 59401

Sen. George McCallum
Box 262
Plains, MT 59859

Dave Wanzenried, Commissioner
Department of Labor & Industry
Helena, MT 59620

Gen. James W. Duffy
Dept. of Military Affairs
1100 N. Last Chance Gulch
Helena, MT 59620

Rep. Earl Lory
4795 Miller Creek Rd.
Missoula, MT 59803

Ardith Aiken, Commissioner
Great Falls City Commission
P.O. Box 5021
Great Falls, MT 59403

Gordon Browder, Chairman
Board of Crime Control
2309 Cloverdale
Missoula, MT 59801

William J. Lannan
University System
33 S. Last Chance Gulch
Helena, MT 59601

Sara Parker
State Librarian
Helena, MT 59620

Daniel Dolan
Office of Public Instruct.
Helena, MT 59620

Lyle Stortz, County Commissioner
Musselshell County
P.O. Box 686
Roundup, MT 59702

APPENDIX B

USER INTERVIEWS

INTERVIEW RECORD

Person Interviewed: Date:

Organization:

Number of Employees in Organization:

Type of Service: Voice ___ Data ___ Other ___

Is present service adequate for needs of organization?

Are there any expected changes in the organization?

Change in size in percentage:

More or less centralization:

Change in technical requirements:

Data

Video

Facsimile

Mobile Radio

Remote Sensing

Roadside Emergency Phones

Highway Telemetry

Is there a disaster recovery responsibility within the organization?

Has organization used the teleconferencing facility?

Would a video conferencing capability be used?

Interviewer:

AGENCIES INTERVIEWED

Department of Administration

Department of Agriculture

Montana Arts Council

State Auditor's Office

Office of Budget and Program Planning

Department of Commerce

Department of Fish, Wildlife and Parks

Governor's Office

Department of Health and Environmental Sciences

Department of Highways

Montana Historical Society

Department of Institutions

Department of Justice

Department of Labor and Industry

Department of State Lands

Legislative Council

Legislative Fiscal Analyst

State Library

Department of Livestock

Department of Military Affairs

Department of Natural Resources and Conservation

Office of Public Instruction

Public Service Commission

Department of Revenue

Secretary of State

Department of Social and Rehabilitation Services

Supreme Court

Montana University System

Eastern Montana College
Montana College of Mineral Science and Technology, Butte
Earthquake Studies Office, Montana Bureau of Mines and Geology
Montana State University
University of Montana
Northern Montana College

Miles Community College

DEPARTMENT OF ADMINISTRATION

VOICE

- Voice service is meeting needs

DATA

- Activities of divisions of the Department of Administration are vital to the work of other State agencies. All are interdependent with, e.g.,
  - Purchasing
  - Architecture and Engineering
  - Treasury
  - Information Services
  - Publications and Graphics
- Interested in machine readable and electronically indexed
  - Administrative Rules of Montana
  - Personnel policies
  - Operations manual
- Electronic mail and calendaring can improve communications, reduce use of paper and photocopy

Interviewed: Ellen Feaver, Director
Dave Ashley, Deputy Director

DEPARTMENT OF AGRICULTURE

VOICE

- -Voice service is meeting needs
- -Teleconferencing supports some Board meetings

DATA

- -Eight personal computers in the Scott Hart Building share access to a disk memory
- -Personal computers are being installed in the district offices; hope to add communications capabilities
- -The U. S. Department of Agriculture is encouraging the use of electronic mail in communication with their offices
- -Access on-line databases, e.g., a pesticide database at Purdue University in Indiana

98 employees, plus 20 additional in summer

Interviewed: Ralph Peck, Deputy Director

MONTANA ARTS COUNCIL

VOICE

-Voice service is meeting needs

DATA

-Linked into 10-state ARTSNET, supported by the Western States Arts Foundation, based in Santa Fe

-Seeking ways that communications technology can help in linking Montana's high proportion of artists with one another, and with their markets.

-Building coalitions of arts organizations

Interviewed: David Nelson, Director
Bill Pratt, Organizational Services Director

STATE AUDITOR'S OFFICE

VOICE

- Voice service is meeting needs

DATA

- The office is responsible for
  - Payroll and Warrant writing
  - Insurance activities within Montana
  - Securities activity within Montana
- An office automation project is now underway
- Payroll now operates as a batch processing system in the mainframe; working toward direct on-line terminal processing by the agencies instead of current paper forms for input.
- In insurance and securities, working toward electronic on-line report filing -- both by companies to State, and State to national databases

Interviewed: Dick Gilbert, Deputy Auditor
Richard Hall

OFFICE OF BUDGET AND PROGRAM PLANNING

VOICE

- Voice service is meeting needs

DATA

- As other departments and agencies carry forward their automation projects, OBPP may have easier and more direct access to information
- Dependent to a large degree on efforts other agencies make in getting budget planning information into machine-readable form

Interviewed: Dave Hunter, Director
Doug Booker, Budget Office

DEPARTMENT OF COMMERCE

VOICE

-Voice service is meeting needs

DATA

-Currently have direct terminal access to mainframe

-Investigating a minicomputer system to support a departmental management system

-Local government relations responsibilities include:

  -Pass-through grants
  -Auditing functions
  -Technical assistance
  -Housing programs

-Some local government would like to provide report data on-line, and this is a direction for the future

-Lieutenant Governor Turman directed a project to support better information exchange between local governments and state government

260 employees in Helena

Interviewed: Keith Colbo, Director
Andy Poole
Alene Gorecki

DEPARTMENT OF FISH, WILDLIFE AND PARKS

VOICE

-Voice service is meeting needs

DATA

-Developing a plan to provide data links from seven regional offices with Helena

-Interested in electronic mail

-Foresee development of databases for

  -License Drawing
  -Violators

-In dealing with violators, it would be useful also to have access to Motor Vehicle and Drivers License databases

-Research laboratory in Bozeman is making increasing use of national databases

Approximately 400 employees: 75 in Helena, 70 in 7 Regional Offices; Wardens working out of homes; Fisheries & Biologists

Interviewed: Sharon Garden, Centralized Services Division
Jim Hermann, License Bureau

GOVERNOR'S OFFICE

VOICE

- -Voice service is meeting needs

EMERGENCY COMMUNICATIONS

- -Governor requires the ability to communicate while in transit within the State; important that the Governor can receive or send critical messages, wherever he is in Montana
- -Requires the ability to communicate with the area in the event of a disaster or emergency anywhere in the State
- -Requires communications into the broadcast media to reach the public quickly and effectively in the event of an emergency

Interviewed: Ted Schwinden, Governor

DEPARTMENT OF HEALTH AND ENVIRONMENTAL SCIENCES

VOICE

- -Voice communications is meeting needs
- -Considerable voice communications with local health authorities

DATA

- -Considerable exchange of information and reporting with Federal agencies; 85% of department budget is from Federal funds, largely earmarked.
- -Federal priorities change; considerable emphasis now on toxic waste problems and on AIDS

RADIO

- -Concern expressed about need for better coordination of emergency radio needs -- for emergency medical services and for disaster coordination

Interviewed: John Drynan, MD, Director
Bill Opitz, Deputy Director

DEPARTMENT OF HIGHWAYS

VOICE

-Voice service is meeting needs

DATA

-Eleven district and area offices now have IBM System 1 computers

-A Digital Equipment Company VAX computer with a package for Computer-Assisted Design (CAD) has been implemented in Helena Headquarters. Eventually would like to make this capabilities accessible to highway project managers around the state

-Data is now exchanged, some by facsimile, for payroll and personnel information with field offices

-Already 30+ personal computers in the headquarters building, and more coming. Experiencing reduced response time in links with the Mitchell Building mainframe

RADIO

-Converted to high band radio

-Coordinating dispatch with the Highway Patrol

1800 employees, all across the State

Interviewed: John Prebil, Deputy Director
Ron Haraseth, Manager Communications
Mike Randall, Systems and Programming

MONTANA HISTORICAL SOCIETY

VOICE

- -Voice service is meeting needs
- -Respond by telephone to growing number of research inquiries

DATA

- -Project is underway with links to a nationwide database, to catalog the holdings of Montana newspapers, and thus make them more accessible to researchers
- -Direct telephone line for typesetting MONTANA magazine
- -Possible future links to subscription fulfillment service database in Ohio for MONTANA magazine
- -Increasing use of dial-up data access; e.g., to database in Missoula of archeological site information

52 employees in Helena, including 7 at separate Historic Preservation office

Interviewed: Robert Archibald, Director
Brian Cockhill, Administration, Centralized Services

DEPARTMENT OF INSTITUTIONS

VOICE

- Voice service is meeting needs
- Because of the wide distribution of institutions and staffs having 24 hour/day responsibilities, while management is based in Helena, effective communication links are critical

DATA

- The Department is establishing a communications network linked to its own IBM System 38
- Applications to be supported will include:

  Caseload Management

  - for Corrections
    - including both
      - institutional clients, and
      - outside clients
  - for Mental Health

2300 employees, including 170 in Helena

Interviewed: Curt Chisholm, Deputy Director

DEPARTMENT OF JUSTICE

VOICE

- Voice service is meeting needs

DATA

- Criminal Justice Information Network (CJIN) now supports 80+ terminals in 50 counties, available 24 hours per day
- Use of CJIN is growing rapidly
- Provides direct gateway to FBI files
- CJIN availability is critical, thus a remote back-up system and redundant circuit links are high priority

RADIO

- Working to better integrate the radio network, to improve officer dispatching
- Seeking to improve use of mutual aid frequencies
- Would like a capability to issue an "All Points Bulletin" statewide

Interviewed: Susan Hansen
Gerry Rymes
Robert Landon
Dutch Meyers

DEPARTMENT OF LABOR AND INDUSTRY

VOICE

- -Voice service is meeting needs

DATA

- -Automated systems already in place include:
  - -Job matching system for Job Service offices
  - -Benefits automation project for Workers Compensation
- -Implementing electronic mail system to link 28 sites
- -Pursuing further automation of central office functions, including link to Workers Compensation Building
- -Department administrators Statewide Occupational Information Coordinating Committee (SOICC) activity
- -The Montana Career Information System (MCIS) is administered under the Department
- -Considerable exchange of information with the U. S. Bureau of Labor Statistics

750 employees

Interviewed: Dave Wanzenried, Commissioner
Rod Sager, Administrator, Centralized Services Division
Roy Hickman, Data Processing Manager
Larry DeFrance, Systems Analyst

DEPARTMENT OF STATE LANDS

VOICE

- -Voice service is meeting needs

DATA

- -Area offices have computers, and data communications needs are increasing
- -Bringing a "Trust Land Management System" on line; area offices will want access to this
- -Seeking better information dissemination capabilities to field offices

RADIO

- -Have extensive mobile radio use -- especially in meeting fire-fighting needs
- -Considerable coordination with the U.S. Forest Service, and with other agencies of government

265 employees, including 80 in Helena and 50 in Missoula (approximately 400 in summer)

Interviewed: Dennis Hemmer, Commissioner

LEGISLATIVE COUNCIL

VOICE

-Voice service is meeting needs

DATA

-Heavy use of data links within the Capitol building

-Heavy test composition and printing needs during the Legislative Session; print 40,000-50,000 pages per year

  -Reports
  -Minutes
  -Bill drafting

-Bill status system is accessed on-line by users outside the Capitol

-Batch update of bill status database allows multiple search

44 employees (110 during the Legislative Session)

Interviewed: Lee Heiman

LEGISLATIVE FISCAL ANALYST

VOICE

- Voice Service is meeting needs

DATA

- Office has three terminals linked to the Central Data Center mainframe to support the Legislative Interactive Budgeting system
- Interested in electronic mail; would be particularly valuable during the budget analysis period
- Make use of the National Council of State Legislators database, by dialing up the system based in Denver
- Subscribe to econometrics database

Interviewed: Jim Haubein
Keith Wolcott

STATE LIBRARY

VOICE

- -Voice service is meeting needs
- -Use the teleconference capability for some meetings

DATA

- -Now implementing a Natural Resource Information System based at the State Library
- -Will provide on-line access or answers to telephone inquiries
- -A number of Montana public and academic libraries share in the Western Library Network (WLN), based in the state of Washington. There are significant telecommunications costs, and the library community is interested in shared network approaches to providing these links
- -The State Library is funded now to provide searches of information databases; it is desired that such searches not become fee-based
- -More direct home delivery of library materials is foreseen over time

640 libraries in Montana

Interviewed: Sara Parker, State Librarian
Sheila Cates, Coordinator of Library Services

DEPARTMENT OF LIVESTOCK

VOICE

-Voice service is meeting needs.

DATA

-Maintain a Brands database, identifying over 65,000 brands; would like to make this available on-line to inspectors in major cattle markets.

-Certain livestock diseases are required to be reported to the State Veterinarian "by the fastest means possible" to avoid spread; better telecommunications links can support such reporting.

-Access Federal Brucellosis Information database, and other USDA information.

-Access file of information on ranch and farm mortgages.

RADIO

-Inspectors have high band radios; work with sheriff's offices and highway department in communications.

Interviewed: John Skufca, Centralized Services Division
Donald Ferlicka, DVM, State Veterinarian
Lorrane Dressler, Purchasing and Supply Officer

DEPARTMENT OF MILITARY AFFAIRS

VOICE

- -Have OPX line to Bozeman for connection with Autovon network
- -OPX links also with Fort Harrison and Helena Airport

DATA

- -Backup mainframe computer being moved from Mitchell Building to Armory
- -New telecommunications links required between Armory and Mitchell Building to interconnect the computers
- -Military Affairs has minicomputer systems in Helena Armory and in Bozeman
- -Approximately 65% of military operations are based at Fort Harrison, where Federal government has a Burroughs computer
- -Disaster and Emergency Services operates with Military Affairs and has satellite link with the Federal Emergency Management Administration (FEMA) communications

RADIO

- -Operates SECURE radio system, linking Military Affairs and DES people in counties for use in emergencies

100 people in Department of Military Affairs; approximately 750 including National Guard.

Interviewed: Maj. Ken Cottrill, Administrator, Centralized Services

DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION

VOICE

- -Voice service is meeting needs
- -Teleconferencing capability used for some Board meetings
  - -Board of Natural Resources
  - -Board of Water Well Contractors
  - -Board of Oil and Gas

DATA

- -Maintain a Water Rights database in Helena, accessed by Helena people, by the Water Courts people in Bozeman, and by the Billings Water Rights Office
- -Oil and Gas office in Billings developing computer applications
- -Increased use also of other databases outside Montana through dial-up use

250 employees, with 180 in Helena

Interviewed: John Armstrong, Administrator, Centralized Services
George Cawlfield
Jerry Smith

OFFICE OF PUBLIC INSTRUCTION

VOICE

-Voice service is meeting needs

DATA

-Developing a "Bulletin Board", providing on-line access for message switching and for exchange of public domain software

-Access EDLINE supported by the Association of Chief State Education Officers

-Other national data base services are used, both by OPI personnel and, with their assistance, by school district personnel, such as

- -ERIC
- -SPECIALNET
- -AGNET
- -VOCNET
- -COMPUSERVE

OTHER

-Interested in capabilities of video teleconferencing for instruction and other purposes; Helena Audio-Visual Center now receives such programs

130 in Helena, 56 County Systems, 551 School Districts

Interviewed: Ed Argenbright, Superintendent
Bill Anderson, Deputy Superintendent
Dan Dolan, Mathematics and Computer Education Specialist

PUBLIC SERVICE COMMISSION

VOICE

- -Voice service is meeting needs
- -Considering an In-WATS number for consumer access

DATA

- -Have a data link to the Data Center in the Mitchell Building
- -Acquiring additional IBM PC's and more data links
- -An IBM System 36 will support
    - -Registration of motor carriers (now 6000+ in the database)
- -Interested in ability to accept and process machine readable data from the utilities

40 Employees

Interviewed: Madeline Cottrill, Administrator, Centralized Services Div.
Wayne Budt, Administrator, Transportation Division
Dan Elliott, Administrator, Utility Division

DEPARTMENT OF REVENUE

VOICE

- Voice service is meeting needs

DATA

- A number of data processing projects now underway have communications implications:
  - Child Support Enforcement offices have personal computers and communications links
  - Property Assessment function is being automated; databases in some cases shared with the counties
  - Moving toward enabling some state accounting firms to file corporate tax returns on-line
  - Terminals in Helena support system for Motor Fuels taxes
  - A major rewrite of the Tax Code is being developed and edited in machine-readable form

1036 employees

Interviewed: Jack Ellery, Deputy Director
Brenda Haseman

SECRETARY OF STATE

VOICE

- -Voice service is meeting needs
- -Respond to inquiries, e.g., on corporation registration

DATA

- -Developing an automated system for the Uniform Commercial Code (UCC)
- -May later develop a comparable system for corporation registration information
- -Considering the provision of on-line access, provided initially to the State's larger law firms and banks
- -SB124 requires that public access be provided to information on agricultural liens
- -In the longer term, considering automated voter registration files -- with possible links to county clerk's offices

35 employees, all in Helena

Interviewed: Larry Akey, Executive Assistant

DEPARTMENT OF SOCIAL AND REHABILITATION SERVICES

VOICE

-Voice services are meeting needs

DATA

-The need for SRS operations is in inverse proportion to the State of Montana's economy

-The Department has assumed operational responsibility for the thirteen largest county SRS offices

-In forty other counties, the State and counties operate with shared funding

-Because of these county-based responsibilities, a large number of reports and updates are being exchanged

-Now working with an IBM Applications Transfer Team toward implementing on-line database systems for:

- -Vocational Rehabilitation
- -Developmental Disability
- -Contracting System for Economic Assistance

-The income maintenance programs now support 8000+ families in Montana, to provide Aid to Families with Dependent Children and Medicare payments

-This provides payments to more people than the State payroll system

-In determining eligibility, it would be useful for SRS to be able to access:

- -Job Service files
- -Property Assessment files
- -Motor Vehicle files

1100 employees, including offices in all 56 counties

Interviewed: Ben Johns, Deputy Director
Pat Godbout, Administrator, Audit and Program Compliance Division

SUPREME COURT

VOICE

- -Voice service is meeting needs
- -Conferencing capability may better support assignment by Justices to District Judges

DATA

- -Increasing use in Helena of IBM 5520 word processing system; used by the Court Justice's offices, the Law Library, and the Clerk of the Court
- -Inputs of information are increasingly on standardized forms, with a view toward further data processing applications
- -Law Library provides dial-up access to WEST LAW and other on-line databases
- -Interested in direct update to personnel files and SBAS

40 employees, all in Helena

Interviewed: Mike Abley, Administrator

MONTANA UNIVERSITY SYSTEM

VOICE

- -Interested in exploring student access to the State's network
- -Would like more detailed telephone accounting capabilities on the campuses
- -Making increasing use of teleconferencing for meetings

DATA

- -Campuses are acquiring new mainframe computers, and pursuing improved telecommunications linkages among them to support
    - -Access from one campus to computing facilities at another
    - -Exchange of programs and files
    - -Consolidation of student enrollment information and accounting data for system-wide use
- -Establishing link to Guaranteed Student Loan processing center in Indianapolis, and perhaps links to Montana banks.
- -Interested in improving links and lowering telecommunications costs for campus library use of the Western Library Network (WLN), based in Washington State.

OTHER

- -Regents have recommended increased multi-campus cooperation on extended education and other programs, which can be supported through telecommunications
- -Television capabilities for inter-campus and off-campus instruction, and for cultural programs, is being explored

Interviewed: Bill Lannan
Paul Dunham
Jack Noble

EASTERN MONTANA COLLEGE

VOICE

- -Voice service is meeting needs

OTHER

- -Campus will acquire new DEC VAX computers
- -KEMC Public radio on important service to the Billings community

Interviewed:
Donald Fox, Budget Office
Kenneth Heikes, Administrative Vice President
Edward Neroda, Library Director
Jack Hull, Computer Center
Kenneth Woosley, Director of News and Media

MONTANA COLLEGE OF MINERAL SCIENCE AND TECHNOLOGY, BUTTE

VOICE

- -Interested in more detailed telephone accounting capabilities for the campus

DATA

- -Using link to Helena mainframe for SBAS
- -Have interest in improved exchange of information for personnel and payroll
- -Developing a Ground Water Information database on the campus, which will be accessed from other sites
- -Increasing use of the campus Computer Center from both on and off-campus -- by
    - -Students
    - -Faculty
    - -School districts
    - -Research center

Interviewed: Victor Burt, Director of Fiscal Affairs

EARTHQUAKE STUDIES OFFICE, MONTANA BUREAU OF MINES AND GEOLOGY

NEEDS

- Currently gathers seismic activity information from sites in Southwestern Montana, to record it graphically on equipment in Butte.
- Analog information is carried by low power FM radio to a receiver site outside Butte.
- Functions well spring, summer and fall; but icing on receiver radio antenna renders data unintelligible in winter.
- Interested in any alternatives providing improvement.

Interviewed: Mike Stickney, Director

MONTANA STATE UNIVERSITY

VOICE

- -Voice service is meeting needs
- -Concerned about slow response time with CMC Directory system terminals
- -Cited problems in account code billing
- -Interested in more detailed telephone accounting capability for the campus

OTHER

- -Interested in establishing quarterly meetings among Universities and the Bureau
- -Urge a planning effort to focus public/educational broadcast telecommunications activity in Montana

Interviewed: Marilyn Wessel, Director of Communications
Craig Roloff, Director, Administrative Services
Edward Groenhout, Dean, Art and Archiecture
Noreen Alldredge, Dean of Library
William Moore, Director of Computing Services

UNIVERSITY OF MONTANA

VOICE

- Interested in more detailed telephone accounting capability for the campus
- Problems in using voice grade lines linked on-the-air to KUFM

DATA

- A new DEC VAX 8600 computer will be brought up in December, and a second will be brought on line, with the two coupled as a cluster
- With these additional capabilities, many more campus terminals can be supported (500-600 concurrently); the campus is interested in exploring whether these terminals might be linked through the present telephone system wiring
- With MBA program operating in Billings, expect much telecommunications activity to the Missoula computer
- Foresee much more sharing of information, data, files and programs among the campuses, and with the System administrator

OTHER

- Interested occasionally in satellite or terrestrial links from the campus to broadcast television stations across the State -- to feed programming such as former President Carter's visit next spring.
- University is affiliated with the National University Teleconferencing Network, which currently provides for reception and campus use of instructional programming
- The campus Instructional Materials Center can receive, distribute and/or record and retain educational programming delivered via satellite

Interviewed: Leonard Lewis, Data Processing Manager
Steve Henry, Computer Center Manager
Ken Fielding, Director, Telecommunications

NORTHERN MONTANA COLLEGE

VOICE

- -Pleased with new SL1 system, installed in August, 1985
- -Campus employee is trained to handle telephone moves, adds and changes; working well

OTHER

- -Have installed a DEC VAX computer with a number of campus terminals
- -Grant application made to NTIA U.S. Department of Commerce, to establish public radio and public television facilities on the campus
- -Library interested in automation efforts

Interviewed: Lou Lucke, Computer Services Director
Terrence Thompson, Director of Library

MILES COMMUNITY COLLEGE

NEEDS

- The College has a Title III grant from the U.S. Office of Education to investigate the use of interactive television to support instructional needs in Southeastern Montana

- Working with local school districts, with the University System, and with other agencies in developing programs through which, e.g., language, science and mathematics instructors can reach multiple classes simultaneously

- Interested in coordinating with our network planning

Interviewed: John Koch, Dean
Syd Sonneborn, Director MCC-ITV

APPENDIX C

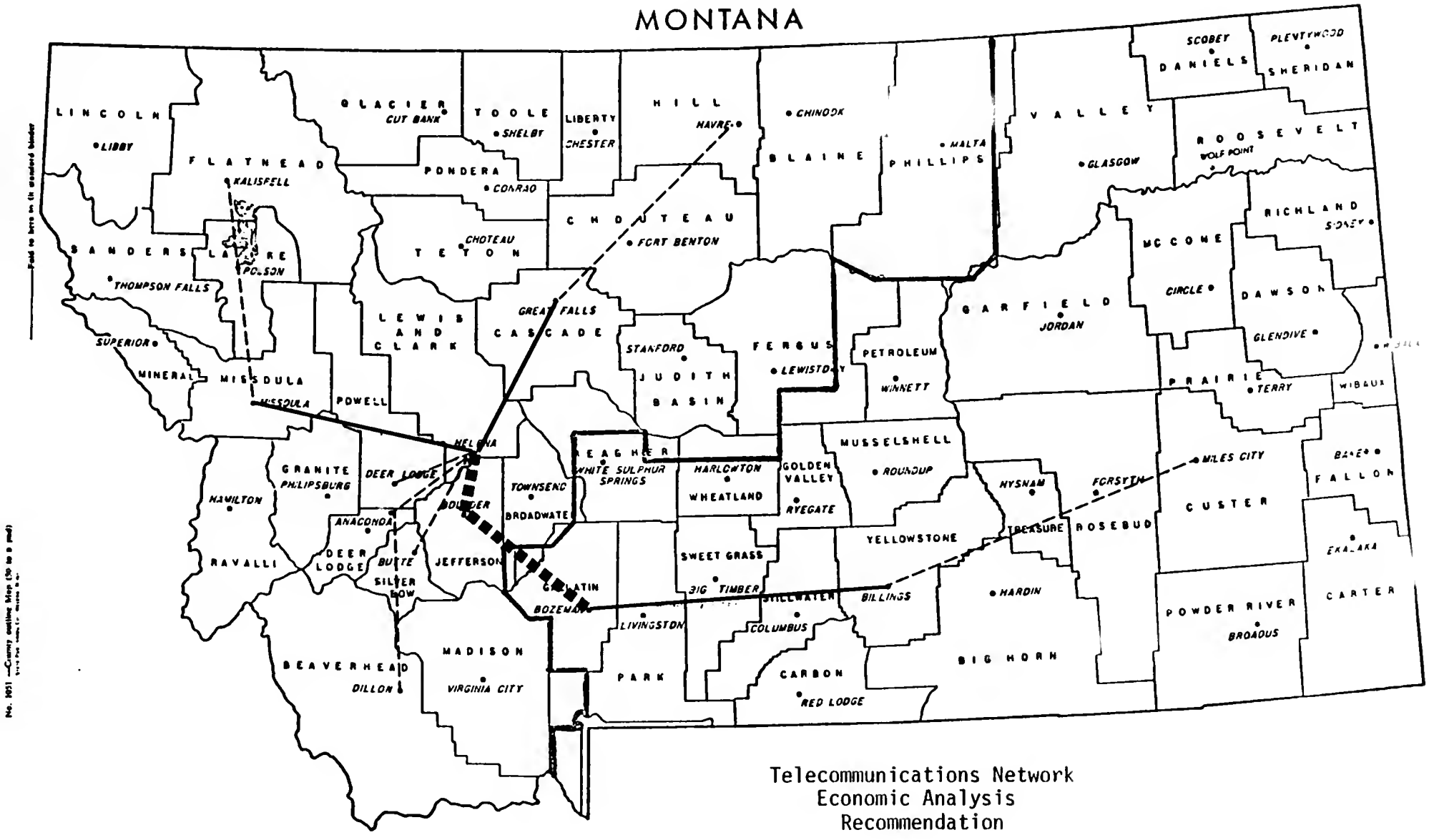
PRESENT WORTH ECONOMIC CALCULATIONS

Present Worth Economic Calculations

Fconomic Analysis Recommendations Facilities Map

Fundamental Plan Microwave Routing Map

	Section
Helena-Bozeman Telecommunications Route Study	1
Helena-Missoula Telecommunications Route Study	2
Helena-Great Falls Telecommunications Route Study	3
Billings-Bozeman Telecommunications Route Study	4
Helena-Butte Telecommunications Route Study	5
Helena-Warm Springs, Helena-Deer Lodge Telecommunications Route Study	7
Missoula-Kalispell Telecommunications Route Study	8
Satellite/Earth Station Telecommunications System Study, 5 Cities	9
Small Earth Terminal Data Systems Study	10
Fiber Optic Route Study	11

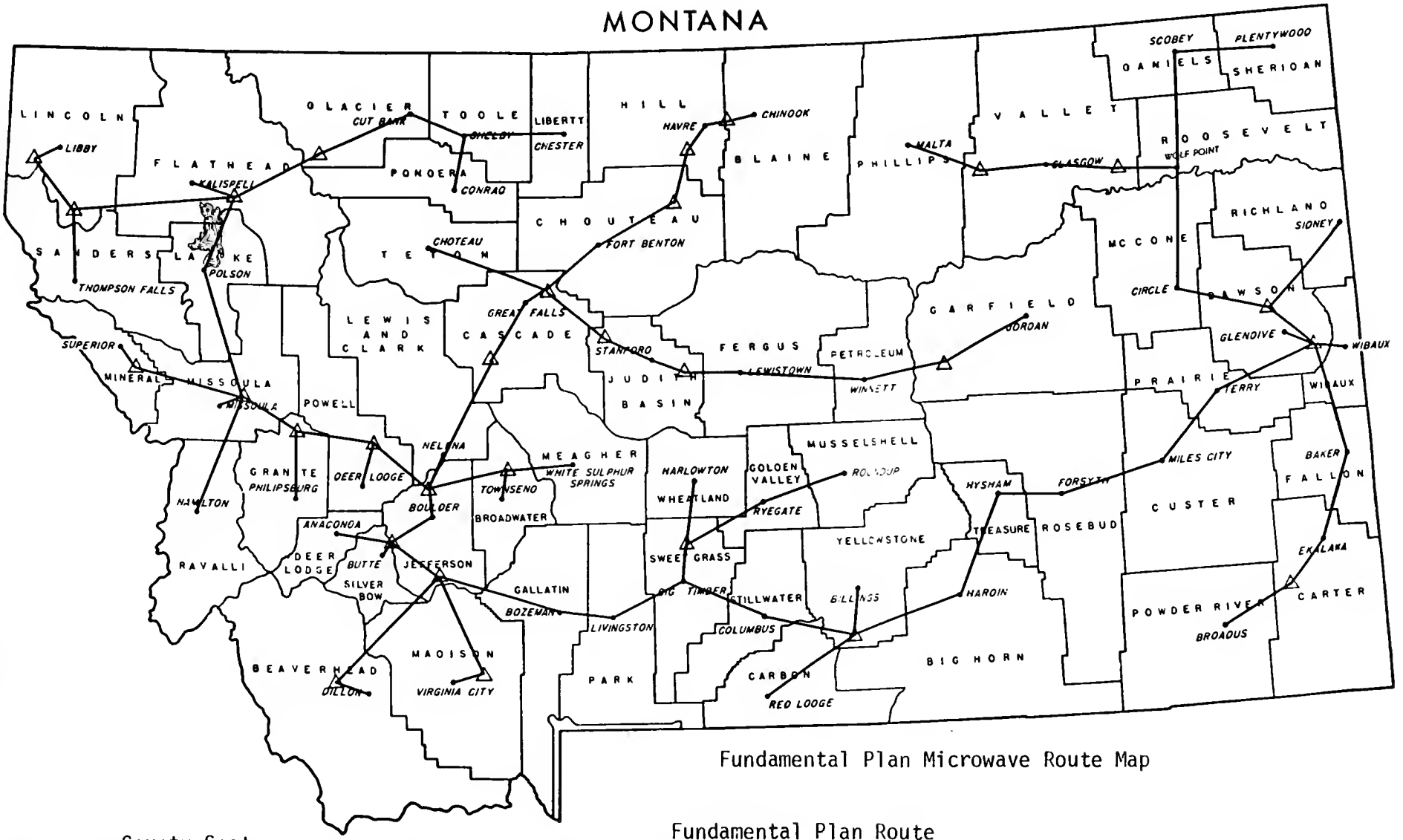


Telecommunications Network
Economic Analysis
Recommendation

■■■■■■■■ Microwave Radio

———— T1 Circuits, Near Term

– – – – – – – – T1 Circuits, Future



Fundamental Plan Microwave Route Map

• County Seat

△ Repeater

_____ Fundamental Plan Route

Fold to here to fit standard holder

No. 1051 —County outline Map (50 to a pad)

SECTION 1

HELENA-BOZEMAN

TELECOMMUNICATIONS ROUTE STUDY

HELENA-BOZEMAN ROUTE CIRCUIT REQUIREMENTS

	86	88	90	92	94	96
Helena-Bozeman, 10FX, 20 tie-lines, 2 data	34	35	37	38	40	41
Helena-Billings, 22 voice, 3 data	27	28	29	30	32	33
Bozeman-Missoula, 6 voice	7	7	8	8	8	9
Billings-Missoula, 6 voice	7	7	8	8	8	9
Adjustment for rounding	0	1	-1	0	0	0
TOTAL	75	78	81	84	88	92

5% added to 1986 requirement to account for estimated overflow to discounted toll on the present system.

Growth estimated at approximately 2% per year.

Cost of Telco circuits increased at 7% per year.

The radios on this route are 192 channel capacity.

The Helena-Bozeman route is unique because Mountain Bell is legally prohibited from transporting circuits across the LATA line which has been imposed between Helena and Bozeman. Circuits are routed via Billings on AT&T facilities and backhauled to Bozeman on Mountain Bell facilities. This routing results in an unusually high circuit cost between Helena and Bozeman.

Five plans are compared in this analysis:

1. Conventional leased circuits routed via Billings

2. T1 Circuits. The transmission medium would be owned by one of the common carriers and the channel banks would be State owned.

3. Microwave radio and T1 channel banks. All facilities would be State owned. Boulder is a repeater point and could have access to the network at a small additional expense (not included in these costs).

4. Conventional circuits routed directly from city to city for all the circuits included in the cross section. This is the total cost of these circuits under the present routing. To compare these results with any of the other plans, a factor has been developed to add to each of the other plans to cover the extension of the circuits from Helena and Bozeman to their respective destinations.

5. Conventional circuits routed directly between Helena and Billings using intra-LATA charges. This plan is for illustration only. Federal regulation prevents Mountain Bell from offering this service.

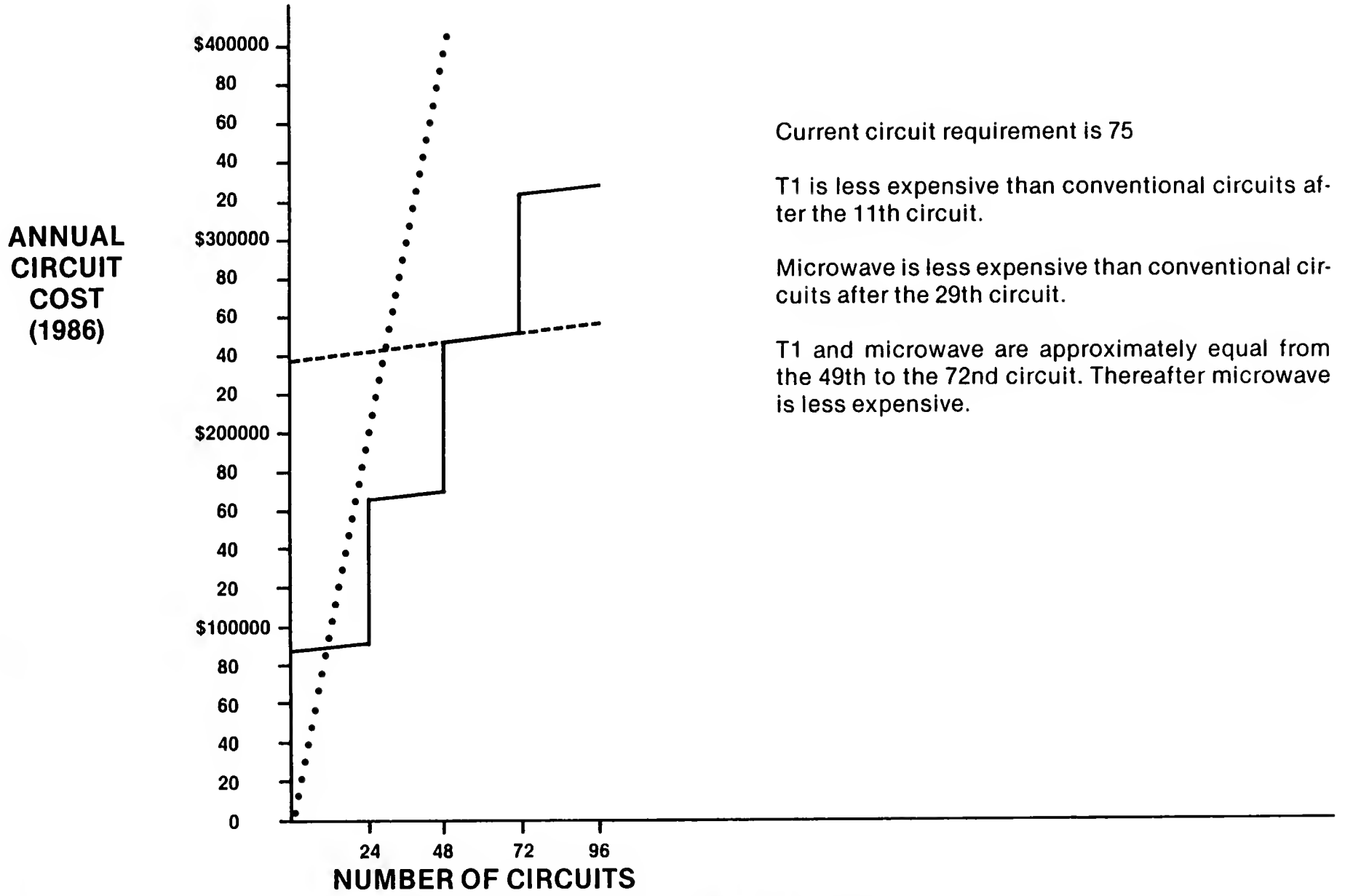
The map illustrates the physical routing of the circuits.

The economic selection study work sheets for each plan include the quantities and costs of all facilities, the annual charges and the calculations.

Summary of Results

	Present Worth of Annual Costs	Description
Plan 1	$5,415,637	Conventional circuits
Plan 2	2,040,657	T1 circuits
Plan 3	1,574,784	Microwave Radio
Plan 4	4,761,131	Conventional circuits routed directly
Plan 5	1,674,659	Conventional circuits without LATA restrictions
Comparison Factor	1,321,525	Add to plans 1,2,3, and 5 to compare with plan 4

The results indicate that microwave radio is the most cost effective method of providing circuits in this route for the circuit quantities used in the analysis. T1 circuits are also economical and would be less expensive than microwave radio at lower circuit requirements. The cost relationships are illustrated in the annual costs for circuit graph.



Current circuit requirement is 75

T1 is less expensive than conventional circuits after the 11th circuit.

Microwave is less expensive than conventional circuits after the 29th circuit.

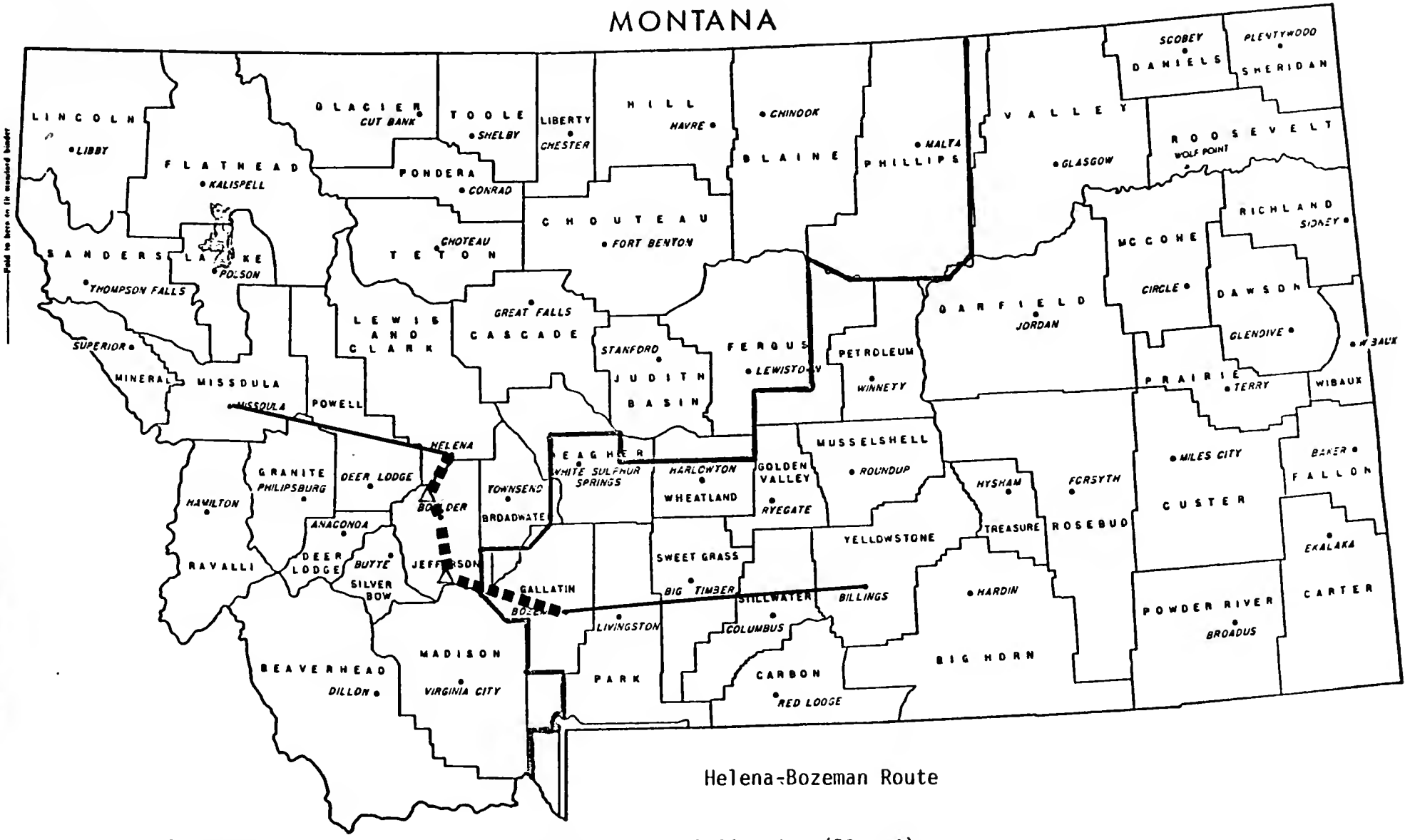
T1 and microwave are approximately equal from the 49th to the 72nd circuit. Thereafter microwave is less expensive.

HELENA — BOZEMAN ROUTE

---------- **Microwave Radio**

———— **T1**

• • • • • • • • • **Conventional Circuits**


MONTANA
LINCOLN
LIBBY
FLATHEAD
KALISPELL
GLACIER
CUT BANK
TOOLE
SHELBY
LIBERTY
CHESTER
HILL
HAVRE
CHINOOK
BLAINE
MALTA
PHILLIPS
VALLEY
GLASGOW
SCOBEY
DANIELS
PLENTYWOOD
SHERIDAN
ROOSEVELT
WOLF POINT
PONDERA
CONRAD
CHOUTEAU
FORT BENTON
TETON
CHOTEAU
SANDERS
LAKE
POLSON
THOMPSON FALLS
RICHLAND
SIDNEY
MCCONE
CIRCLE
DAWSON
GLENDIVE
GARFIELD
JORDAN
PRAIRIE
TERRY
WIBAUX
LEWIS AND CLARK
GREAT FALLS
CASCADE
STANFORD
JUDITH BASIN
FERGUS
LEWISTOWN
PETROLEUM
WINNETT
SUPERIOR
MINERAL
MISSOULA
POWELL
HELENA
EAGLE
WHITE SULPHUR SPRINGS
HARLOWTON
WHEATLAND
GOLDEN VALLEY
MUSSELSHELL
ROUNDUP
MILES CITY
CUSTER
BAKER
FALLON
GRANITE
PHILIPSBURG
DEER LODGE
HAMILTON
TOWNSEND
BROADWATER
BOULDER
RYEGATE
HYSHAM
FORSYTH
ROSEBUD
TREASURE
ANACONDA
DEER LODGE
BUTTE
SILVER BOW
JEFFERSON
RAVALLI
SWEET GRASS
BIG TIMBER
YELLOWSTONE
EKALAKA
GALLATIN
BOZEMAN
STILLWATER
BILLINGS
HARDIN
CARTER
POWDER RIVER
BROADUS
LIVINGSTON
COLUMBUS
MADISON
BEAVERHEAD
DILLON
VIRGINIA CITY
PARK
CARBON
RED LODGE
BIG HORN
Helena-Bozeman Route
County Seat
Repeater
Conventional Circuits (Plan 4)
Microwave Radio Route

ECONOMIC SELECTION STUDY

DESCRIPTION: Helena - Bozeman Telecommunications Route
Conventional Circuits

PLAN 1 OF 5 SHEET 1 OF 1
PREP. BY [illegible] DATE
STUDY PERIOD 86 thru 95

	ITEM	QUANTITY	Monthly UNIT COST	~~CAPITAL REQUIREMENTS~~ ~~FIRST COST~~ Convert To AMOUNT Annual	~~PRESENT WORTH OF FIRST COST~~ DATE OF EXPEND.	FACTOR	AMOUNT	REVENUE REQUIREMENTS ANNUAL COST PER CENT	AMOUNT	PRESENT WORTH OF ANNUAL COSTS PERIOD	FACTOR	AMOUNT
1	Helena - Bozeman Circuits	78	652	x 12.564	86				638,955	10	6.144	3,925,740
2	2% per year	3	746	"	88				28,118	10-2	4.408	123,944
3	increase in circuit	3	855	"	90				32,227	10-4	2.974	95,843
4	requirement.	3	978	"	92				36,863	10-6	1.759	65,948
5		4	1120	"	94				56,287	10-8	.804	45,536
6												
7	Circuit Cost Additions	78	93	x 12.564	88				91,139	10-2	4.408	401,741
8	7%/year	81	109	"	90				110,928	10-4	2.974	329,900
9		84	123	"	92				129,811	10-6	1.789	232,232
10		87	142	"	94				155,216	10-8	.804	125,
11	Total		X									5,346,453
12	One-Time Installation	46	1208		86	1.0						55,568
13	Charge Increased at	3	1383		88							3,429
14	7%/year. Existing	3	1583		90							3,244
15	circuits deducted from	3	1812		92							3,069
16	'86 quantity	4	2076		94							3,874
17	Total											5,415,637
18												
19												
20												

REMARKS: Present worth of annuity factor for 12 monthly payments in advance of year end payment date = 1.047.
12 x 1.047 = 12.564

	NON-STANDARD ANNUAL COST PERCENTAGES (1)	(2)	(3)	(4)	(5)
TYPE OF PLANT					
O OF M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL %					

ECONOMIC SELECTION STUDY

DESCRIPTION: Helena - Bozeman Telecommunications Route
T1 Circuit.

PLAN 2 OF 5 SHEET 1 OF 1
PREP. BY [illegible] DATE 12/26/85
STUDY PERIOD 1986 Thru 1995

	ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS: FIRST COST AMOUNT	CAPITAL REQUIREMENTS: PRESENT WORTH OF FIRST COST DATE OF EXPEND.	CAPITAL REQUIREMENTS: PRESENT WORTH OF FIRST COST FACTOR	CAPITAL REQUIREMENTS: PRESENT WORTH OF FIRST COST AMOUNT	REVENUE REQUIREMENTS: ANNUAL COST PER CENT	REVENUE REQUIREMENTS: ANNUAL COST AMOUNT	REVENUE REQUIREMENTS: PRESENT WORTH OF ANNUAL COSTS PERIOD	REVENUE REQUIREMENTS: PRESENT WORTH OF ANNUAL COSTS FACTOR	REVENUE REQUIREMENTS: PRESENT WORTH OF ANNUAL COSTS AMOUNT
1	Channel Bank Comm. Equip	8	6000	48,000	86	1.0	48,000	22.7	10,896	10	6.144	66,945
2	Channel Units	156	260	40,560	86	1.0	40,560	22.7	9,207	10	6.144	56,568
3	Channel Units	6	260	1,560	88	.8264	1,289	22.7	354	10-2	4.408	1,560
4	Channel Units	6	260	1,560	90	.6830	1,065	22.7	354	10-4	2.974	1,053
5	Channel Units	6	260	1,560	92	.5645	881	22.7	354	10-6	1.789	633
6	Channel Units	8	260	2,080	94	.4665	970	22.7	472	10-8	.809	382
7	Total						92,765					
8			Monthly Charge	Total monthly charge	Convert to Annual		Annual					
9	T1 Facility, Helena - Bozeman	4	5000	20,000	x12x	1.047	251,280			10	6.144	1,543,864
10												
11	Local Connection	2	1000	2,000	x12x	1.047	25,128			10	6.144	154,386
12	Local Connection	6	400	2,400	x12x	1.047	30,154			10	6.144	185,266
13	Total			24,400			306,562					
14	1 Time Charge 1st T1	1	2400	2,400	86	1.0	2,400					2,400
15	1 Time Charge Additional T1s	3	1200	3,600	86	1.0	3,600					3,600
16	1 Time Charge 1st Local Con.	2	6000	12,000	86	1.0	12,000					12,000
17	1 Time Charge Additional L.C.	6	2000	12,000	86	1.0	12,000					12,000
18	Total						30,000					
19												
20	Total											2,040,657

REMARKS: Channel Banks owned by State.
T1 Facilities Paid Monthly.

	NON-STANDARD ANNUAL COST PERCENTAGES (1)	(2)	(3)	(4)	(5)
TYPE OF PLANT	MW+Mux				
C OF M	10.0				
PROPERTY TAX	0				
INCOME TAX	0				
DEPRECIATION	6.7				
MAINTENANCE	6.0				
TOTAL %	22.7				

ECONOMIC SELECTION STUDY

DESCRIPTION: Helena – Bozeman Telecommunications Route Microwave Radio And T1 Channel Banks

PLAN 3 OF 5 SHEET 1 OF 2
PREP. BY M DATE
STUDY PERIOD 1986 – 1995

	ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS: FIRST COST AMOUNT	PRESENT WORTH OF FIRST COST: DATE OF EXPEND.	PRESENT WORTH OF FIRST COST: FACTOR	PRESENT WORTH OF FIRST COST: AMOUNT	REVENUE REQUIREMENTS: ANNUAL COST PER CENT	ANNUAL COST AMOUNT	PRESENT WORTH OF ANNUAL COSTS: PERIOD	PRESENT WORTH OF ANNUAL COSTS: FACTOR	PRESENT WORTH OF ANNUAL COSTS: AMOUNT
1	Digital MW Radios, Term.	2	54,900	109800	86	1.0	109 800	22.7	24925	10	6.144	153 139
2	Digital MW Radios, Rptr.	6	50,400	302400			302 400	22.7	68645			421 755
3	Antenna System	8	9,000	72000			72 000	22.7	16344			100 418
4	Battery & Power	5	5,600	28000			28 000	22.7	6356			39051
5	AC Generator	5	35,000	175000			175 000	21.7	37975			233 318
6	Spares	1 Lot	50,000	50000			50 000	22.7	11350			69734
7	Land and Site Work	2	30,000	60000			60 000	18.0	10800			66355
8	Building	2	25,000	50000			50 000	21.7	10850			66662
9	Site Work at Exist. Bldgs	3	5,000	15000			15 000	21.7	3255			19999
10	Towers 150 ft	2	62,000	124000			124 000	21.7	26908			165334
11	Tower, Stub 30 ft	3	16,000	48000			48 000	21.7	3212			19736
12	Survey, FCC License, Freq. Coord	1 Lot	14,800	14,800			14 800	16.7	2472			15188
13	System Design		75,000	75,000			75 000	16.7	12525			76954
14	Channel Bank Comm. Equip.	8	6,000	48,000			48 000	22.7	10896			66945
15	Channel Units	156	260	40,560	↓	↓	40 560	22.7	9207	↓	↓	56568
16	Channel Units	6	260	1,560	88	.8264	1289	22.7	354	10-2	4.408	1560
17	Channel Units	6	260	1,560	90	.6830	1065	22.7	354	10-4	2.974	1053
18	Channel Units	6	260	1,560	92	.5645	881	22.7	354	10-6	1.789	633
19	Channel Units	8	260	2080	94	.4665	970	22.7	472	10-8	.809	382
20	Total			1,219,320			1,216,765		257254			1,574,784

REMARKS: Costs are installed costs. Depreciation based on 15 year life, straight line. Maintenance includes labor and material and State employee supervision (administrative). Survey and Design work annual charges have no maintenance content.

NON-STANDARD ANNUAL COST PERCENTAGES

	(1)	(2)	(3)	(4)	(5)
TYPE OF PLANT	MW & MUX	Towers	Buildings	Land	A C. Gen
C OF M	10	10	10	10	10
PROPERTY TAX	0	0	0	0	0
INCOME TAX	0	0	0	0	0
DEPRECIATION	6.7	6.7	6.7	0	6.7
MAINTENANCE	6	5	5	8	5
TOTAL %	22.7	21.7	21.7	18	21.7

ECONOMIC SELECTION STUDY

DESCRIPTION: Helena - Bozeman Telecommunications Route
Microwave Radio and T1 Channel Banks

PLAN 3 OF 5 SHEET 2 OF 2
PREP. BY h DATE
STUDY PERIOD 1986 - 1995

Remaining Life Credit.

	ITEM	First ~~QUANTITY~~ Cost	Credit ~~UNIT~~ Factor ~~COST~~	CAPITAL REQUIREMENTS: Credit ~~FIRST COST~~ AMOUNT	PRESENT WORTH OF Credit ~~FIRST COST~~: DATE OF EXPEND.	FACTOR	AMOUNT	REVENUE REQUIREMENTS: ANNUAL COST PER CENT	AMOUNT	PRESENT WORTH OF ANNUAL COSTS: PERIOD	FACTOR	AMOUNT
1	Digital MW Radio	1124560	.333	374,478	96	.3855	144,361					
2	System including Radios											
3	Antennas, Batteries,											
4	Generators, Spares,											
5	Buildings, Towers, Surveys,											
6	Design and Site Work and											
7	Initial Channels											
8												
9	Land, Repeater Sites	40,000	1.00	40,000	96	.3855	15,420					
10												
11	Channel Units	1560	.467	729	96	.3855	281					
12		1560	.60	936	96	.3855	361					
13		1560	.733	1143	96	.3855	441					
14		2080	.867	1903	96	.3855	734					
15												
16												
17												
18												
19												
20	Total						161,598					

REMARKS: Remaining life credit for 5 years of 15 year life is .333. Land is credited at 100% of First Cost. This information for reference only.

	NON-STANDARD ANNUAL COST PERCENTAGES (1)	(2)	(3)	(4)	(5)
TYPE OF PLANT					
O OF M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL %					

ECONOMIC SELECTION STUDY

DESCRIPTION: Helena - Bozeman Telecommunications Route
Circuits Routed Directly - Common Carrier

PLAN 4 OF 5 SHEET 1 OF 2
PREP. BY M DATE
STUDY PERIOD 1986 thru 1995

	ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS: FIRST COST Convert To Annual AMOUNT	CAPITAL REQUIREMENTS: PRESENT WORTH OF FIRST COST DATE OF EXPEND.	FACTOR	AMOUNT	REVENUE REQUIREMENTS: ANNUAL COST PER CENT	ANNUAL COST AMOUNT	PRESENT WORTH OF ANNUAL COSTS PERIOD	FACTOR	AMOUNT
1	Helena - Bozeman	34	652	X 12 X 1.047	86				278,510	2	1.736	483,492
2	Helena - Billings	27	496	X 12 X 1.047	86				168,251	2	1.736	292,084
3	Bozeman - Missoula	7	752	X 12 X 1.047	86				66,134	2	1.736	114,809
4	Billings - Missoula	7	546	X 12 X 1.047	86				52,415	2	1.736	90,993
5	Total											
6	Helena - Bozeman	35	746	X 12 X 1.047	88				328,046	4-2	1.434	470,418
7	Helena - Billings	28	568	X 12 X 1.047	88				199,818	4-2	1.434	286,539
8	Bozeman - Missoula	7	861	X 12 X 1.047	88				75,723	4-2	1.434	108,587
9	Billings - Missoula	7	682	X 12 X 1.047	88				59,981	4-2	1.434	86,012
10	Total											
11	Helena - Bozeman	37	855	X 12 X 1.047	90				397,462	6-4	1.185	470,993
12	Helena - Billings	29	650	X 12 X 1.047	90				236,831	6-4	1.185	280,645
13	Bozeman - Missoula	8	986	X 12 X 1.047	90				99,105	6-4	1.185	117,439
14	Billings - Missoula	8	781	X 12 X 1.047	90				78,500	6-4	1.185	93,022
15	Total											
16	Helena - Bozeman	38	978	X 12 X 1.047	92				466,927	8-6	.980	457,590
17	Helena - Billings	30	744	X 12 X 1.047	92				280,428	8-6	.980	274,820
18	Bozeman - Missoula	8	1129	X 12 X 1.047	92				113,478	8-6	.980	111,208
19	Billings - Missoula	8	894	X 12 X 1.047	92				89,858	8-6	.980	88,061
20	Sub-Total											3,826,712

REMARKS: See page 1 of Plan 1 for Rate Increase Percentages.

These circuits represent the present facility routing of the circuits.

	NON-STANDARD ANNUAL COST PERCENTAGES (1)	(2)	(3)	(4)	(5)
TYPE OF PLANT					
C OF M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL %					

ECONOMIC SELECTION STUDY

DESCRIPTION: Helena - Bozeman Telecommunications Route
Circuits Routed Directly - Common Carrier

PLAN 4 OF 5 SHEET 2 OF 2
PREP. BY M DATE
STUDY PERIOD 1986 thru 1995

(continuation)

	ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS: FIRST COST: Convert To Annual AMOUNT	CAPITAL REQUIREMENTS: PRESENT WORTH OF FIRST COST: DATE OF EXPEND.	FACTOR	AMOUNT	REVENUE REQUIREMENTS: ANNUAL COST: PER CENT	AMOUNT	PRESENT WORTH OF ANNUAL COSTS: PERIOD	FACTOR	AMOUNT
1	Helena - Bozeman	40	1120	X12X1.047	94				562,867	10-8	.809	455,360
2	Helena - Billings	32	852	X12X1.047	94				342,545	10-8	.809	277,119
3	Bozeman - Missoula	8	1292	X12X1.047	94				129,862	10-8	.809	105,058
4	Billings - Missoula	8	1024	X12X1.047	94				102,924	10-8	.809	83,266
5	Total											920,803
6	Subtotal Sheet 1											3,826,712
7	Total PW Annual Costs											4,747,515
8												
9												
10												
11	One Time Installation	3	1383		88	.8264						3,429
12	Charge Increased At	3	1583		90	.6830						3,244
13	Same Percentage As	3	1812		92	.5645						3,069
14	Above.	4	2076		94	.4665						3,874
15	Total											
16												
17												
18									Total Present Worth			4,761,131
19												
20												

REMARKS: Installation Charge for additional study circuits during year 1, 1986 was not included because it would not be incurred if the method of operation does not change. The additional circuit costs are included to represent traffic costs overflowed to other circuits such as WATS.

	NON-STANDARD ANNUAL COST PERCENTAGES (1)	(2)	(3)	(4)	(5)
TYPE OF PLANT					
O OF M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL %					

ECONOMIC SELECTION STUDY

DESCRIPTION: Helena - Bozeman Telecommunications Route
Conventional Circuits - No LATA (See note)

PLAN 5 OF 5 SHEET 1 OF 1
PREP. BY ↑ DATE
STUDY PERIOD 86 Thru 95

	ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS: FIRST COST: Convert To Annual AMOUNT	CAPITAL REQUIREMENTS: PRESENT WORTH OF FIRST COST: DATE OF EXPEND.	FACTOR	AMOUNT	REVENUE REQUIREMENTS: ANNUAL COST: PER CENT	AMOUNT	PRESENT WORTH OF ANNUAL COSTS: PERIOD	FACTOR	AMOUNT
1	Approximate costs	78	200	X 12.564	86				195,992	10	6.144	1,204,175
2	if LATA did not re-	3	229		88				8,631	10-2	4.408	38,045
3	quire special routing:	3	262		90				9,875	10-4	2.974	29,368
4	81 miles at common	3	300		92				11,308	10-6	1.789	20,230
5	carrier mileage charge,	4	344	↓	94				17,288	10-8	.809	13,986
6	$1.6/mile and termination											
7	charge, $70/circuit.											
8												
9	Price Increases at	78	29	X 12.564	88				28,420	10-2	4.408	125,275
10	7%/yr.	81	33		90				33,584	10-4	2.974	99,879
11		84	38		92				40,104	10-6	1.789	71,746
12		87	44	↓	94				48,095	10-8	.809	38,909
13	Total											1,641,613
14	One time installation											26,542
15	Charge. Increased at											1,639
16	7%/yr. Existing											1,549
17	circuits deducted											1,467
18	from '86 quantity.											1,849
19												
20	Total											1,674,659

REMARKS: This plan is for illustration only. Government regulations prevent circuits from being routed across LATA boundaries by Mountain Bell. These costs are based on intra-LATA tariffs. They would be actual costs if the LATA did not exist.

	NON-STANDARD ANNUAL COST PERCENTAGES (1)	(2)	(3)	(4)	(5)
TYPE OF PLANT					
C OF M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL %					

ECONOMIC SELECTION STUDY

DESCRIPTION: Helena - Bozeman Telecommunication Route
Factors To Add To Plans For Comparison With Current Cfts.

PLAN 2-3-5 OF ___ SHEET 1 OF 1
PREP. BY ___ DATE ___
STUDY PERIOD 86 thru 95

	ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS: FIRST COST: Convert to Annual AMOUNT	CAPITAL REQUIREMENTS: PRESENT WORTH OF FIRST COST: DATE OF EXPEND.	FACTOR	AMOUNT	REVENUE REQUIREMENTS: ANNUAL COST: PER CENT	ANNUAL COST: AMOUNT	PRESENT WORTH OF ANNUAL COSTS: PERIOD	FACTOR	AMOUNT
1	Helena - Missoula	14	224	x 12.564	86				39,400	2	1.736	68,398
2	Bozeman - Billings	34	267		86				114,052	2	1.736	197,994
3												
4	Helena - Missoula	14	256		88				45,029	4-2	1.434	64,573
5	Bozeman - Billings	35	306		88				134,560	4-2	1.434	192,959
6												
7	Helena - Missoula	16	294		90				59,101	6-4	1.185	70,035
8	Bozeman - Billings	37	350		90				162,704	6-4	1.185	192,804
9												
10	Helena - Missoula	16	336		92				67,544	8-6	.980	66,193
11	Bozeman - Billings	38	401		92				191,450	8-6	.980	187,621
12												
13	Helena - Missoula	16	385		94				77,394	10-8	.809	62,612
14	Bozeman - Billings	40	459		94				230,675	10-8	.809	186,616
15												
16	One-Time Installation	48	577									27,696
17	Charge	1	661									546
18		4	756									2,065
19		1	866									489
20		2	991									925
											Total	1,321,525

REMARKS:
These factors are the costs of extending the "through" circuits beyond Helena and Bozeman to their terminations.

	(1)	(2)	(3)	(4)	(5)
TYPE OF PLANT					
C OF M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL %					

SECTION 2

HELENA-MISSOULA

TELECOMMUNICATIONS ROUTE STUDY

Three plans are compared in the analysis of the Helena-Missoula route as follows:

1. Conventional circuits as used at present

2. Microwave radio with T1 channel banks, all facilities are State owned. The terminal at Helena and the first repeater have reduced costs because it is assumed that they have been installed for the Helena-Bozeman route.

3. T1 circuits. The transmission medium would be owned by a common carrier and the channel banks would be State owned.

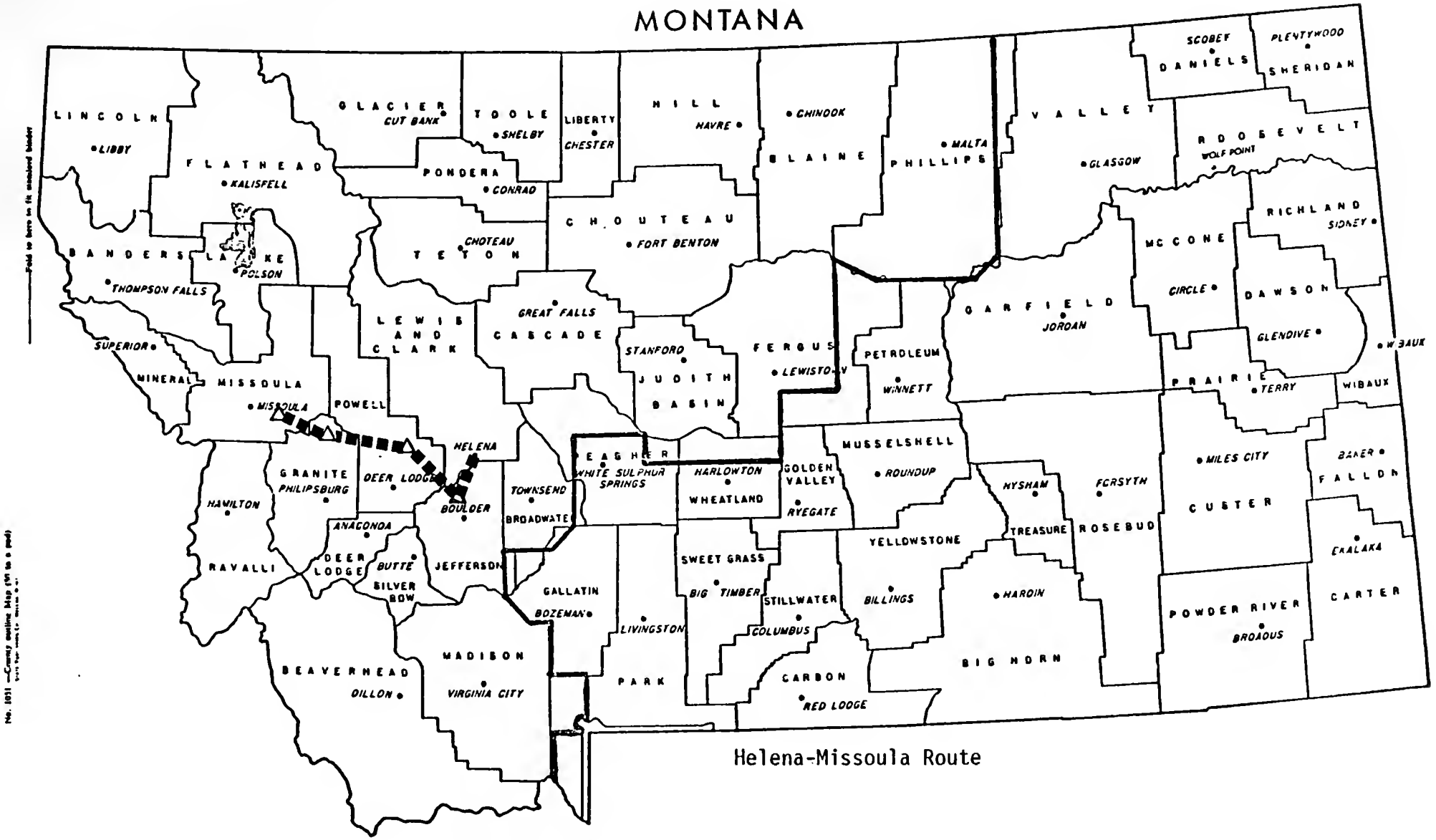
Summary of Results

	Present Worth of Annual Costs	Description
Plan 1	$1,136,442	Conventional circuits
Plan 2	1,551,223	Microwave Radio
Plan 3	665,580	T1 Circuits

The results indicate that T1 is clearly the most cost effective method of providing circuits in this route for the quantities of circuits used in the analysis. The cost relationships for 1986 are illustrated in the annual costs per circuit graph. Note also that the conventional circuits would increase in cost at a compounded rate of 7% per year, while the other methods of providing circuits would remain relatively constant. The conventional circuit line on the graph would swing further toward the vertical on the graph each year.

The map illustrates the physical routing of the microwave system.

The economic selection study work sheets for each plan include the quantities and costs of all facilities, the annual charges and the calculations.


MONTANA
LINCOLN
LIBBY
FLATHEAD
KALISPELL
GLACIER
CUT BANK
TOOLE
SHELBY
LIBERTY
CHESTER
HILL
HAVRE
CHINOOK
BLAINE
PHILLIPS
MALTA
VALLEY
GLASGOW
SCOBEY
DANIELS
PLENTYWOOD
SHERIDAN
ROOSEVELT
WOLF POINT
PONDERA
CONRAD
CHOUTEAU
FORT BENTON
TETON
CHOTEAU
BANDERS LAKE
POLSON
THOMPSON FALLS
RICHLAND
SIDNEY
MC CONE
CIRCLE
DAWSON
GLENDIVE
GARFIELD
JORDAN
WIBAUX
PRAIRIE
TERRY
LEWIS AND CLARK
GREAT FALLS
CASCADE
STANFORD
JUDITH BASIN
FERGUS
LEWISTOWN
PETROLEUM
WINNETT
SUPERIOR
MINERAL
MISSOULA
POWELL
HELENA
EAGLE
WHITE SULPHUR SPRINGS
HARLOWTON
WHEATLAND
GOLDEN VALLEY
RYEGATE
MUSSELSHELL
ROUNDUP
MILES CITY
CUSTER
BAKER
FALLON
GRANITE
PHILIPSBURG
DEER LODGE
BOULDER
TOWNSEND
BROADWATER
HAMILTON
ANACONDA
RAVALLI
DEER LODGE
BUTTE
SILVER BOW
JEFFERSON
GALLATIN
BOZEMAN
SWEET GRASS
BIG TIMBER
YELLOWSTONE
BILLINGS
STILLWATER
COLUMBUS
MYSHAM
TREASURE
FORSYTH
ROSEBUD
HARDIN
EKALAKA
CARTER
POWDER RIVER
BROADUS
BIG HORN
MADISON
VIRGINIA CITY
BEAVERHEAD
DILLON
LIVINGSTON
PARK
CARBON
RED LODGE
Helena-Missoula Route
County Seat
Microwave Radio Route
Repeater

HELENA-MISSOULA ROUTE CIRCUITS REQUIREMENTS

	86	88	90	92	94	96
Helena-Missoula, 27 voice , 1 data	29	31	32	33	34	36
Helena-Kalispell, 1 data	1	1	1	1	1	1
Missoula-Billings, 6 voice	6	6	7	7	7	7
Missoula-Bozeman, 6 voice	6	6	7	7	7	7
Adjustment for rounding	1	1	0	0	1	1
TOTAL	43	45	47	48	50	52

5% added to 1986 requirements to account for estimated overflow to discounted toll on the present system.

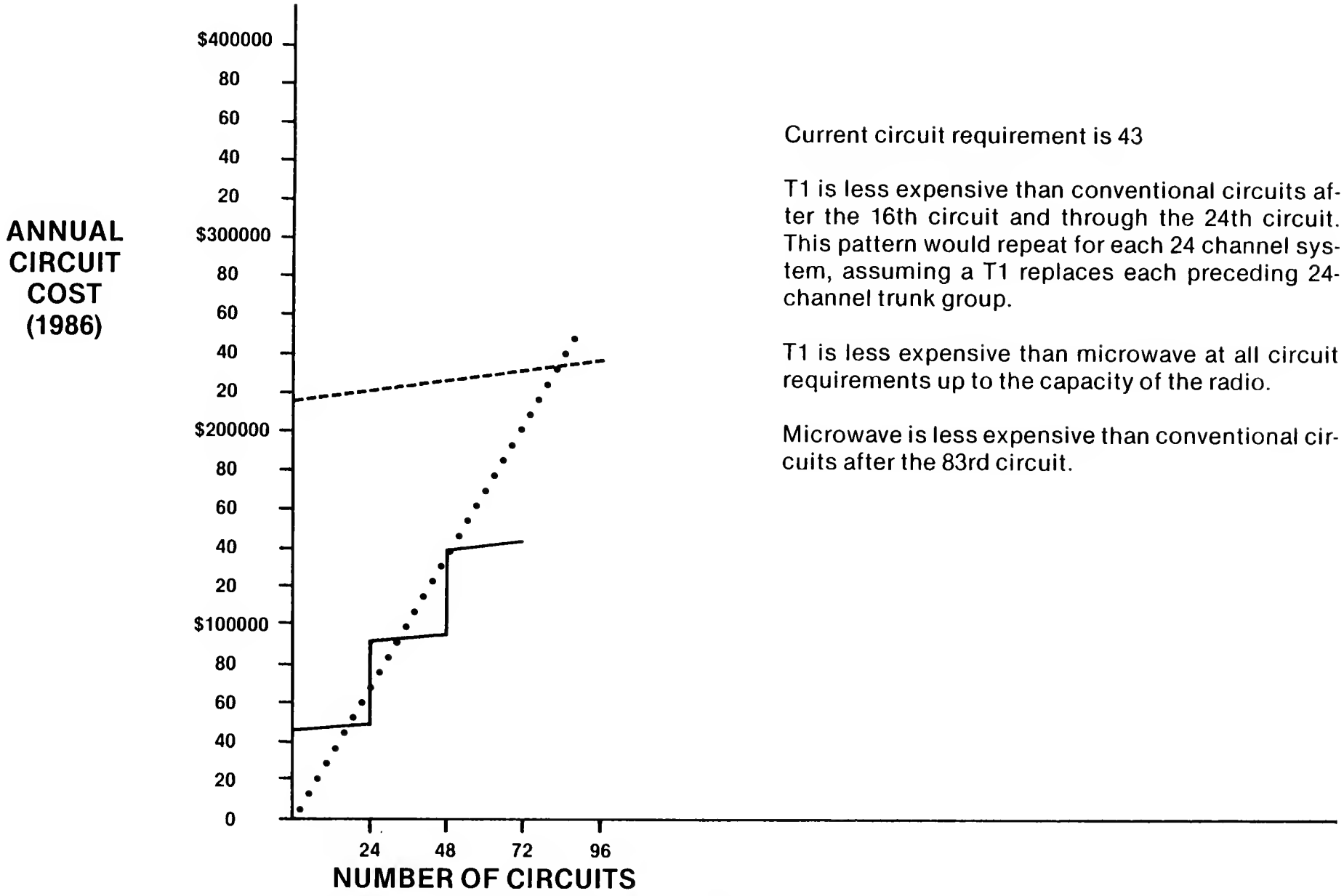
Growth estimated at approximately 2% per year.

Cost of Telco circuits increased at 7% per annum.

48 circuits are installed initially. Additional common equipment and 4 channels are installed in 1992 for growth.

Missoula-Helena has 2 terminals and 4 repeater sites. One repeater site would be in place if the Helena-Bozeman route was installed. The Helena terminal and the repeater site costs reflect the additional equipment added for this route.

The radios on this route are 96 channel capacity.



Current circuit requirement is 43

T1 is less expensive than conventional circuits after the 16th circuit and through the 24th circuit. This pattern would repeat for each 24 channel system, assuming a T1 replaces each preceding 24-channel trunk group.

T1 is less expensive than microwave at all circuit requirements up to the capacity of the radio.

Microwave is less expensive than conventional circuits after the 83rd circuit.

HELENA — MISSOULA ROUTE

---------- Microwave Radio

———— T1

• • • • • • • • • Conventional Circuits

ECONOMIC SELECTION STUDY

DESCRIPTION: Helena - Missoula Telecommunications Route
T1 Circuits

PLAN 3 OF 3 SHEET 1 OF 1
PREP. BY _____ DATE _____
STUDY PERIOD _____

	ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS: FIRST COST AMOUNT	PRESENT WORTH OF FIRST COST: DATE OF EXPEND.	PRESENT WORTH OF FIRST COST: FACTOR	PRESENT WORTH OF FIRST COST: AMOUNT	REVENUE REQUIREMENTS: ANNUAL COST PER CENT	ANNUAL COST AMOUNT	PRESENT WORTH OF ANNUAL COSTS: PERIOD	PRESENT WORTH OF ANNUAL COSTS: FACTOR	PRESENT WORTH OF ANNUAL COSTS: AMOUNT
1	Channel Bank Comm. Equip	4	6000	24,000	86	1.0	24,000	22.7	5,448	10	6.144	33,473
2	Channel Units	96	260	24,960	86	1.0	24,960	22.7	5,666	10	6.144	34,812
3												
4	Channel Bank Comm. Equip	2	6000	12,000	92	.5645	6,774	22.7	1,538	10-6	1.789	2,751
5	Channel Units	8	260	2,080	92	.5645	1,174	22.7	267	10-6	1.789	478
6												
7												
8			Monthly Charge	Factor To Convert To Annual			Annual					
9	T1 Facility	2	3332	12.564	86		83,726			10	6.144	514,413
10	T1 "	1	3332	12.564	92		41,863			10-6	1.789	74,893
11												
12												
13	1 Time Charge 1st ckt	1	2100		86	1.0						2,100
14	1 Time Charge Subsequent	1	1700		86	1.0						1700
15	" " "	1	1700		92	.5645						960
16												
17	Total											
18												665,580
19												
20												

REMARKS:
T1 costs are from Mt. Bell based on 5 year contract

	NON-STANDARD ANNUAL COST PERCENTAGES (1)	(2)	(3)	(4)	(5)
TYPE OF PLANT					
O OF M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL %					

ECONOMIC SELECTION STUDY

DESCRIPTION: Helena - Missoula Telecommunications Route
Conventional Circuits

PLAN 1 OF 3 SHEET 1 OF 1
PREP. BY [illegible] DATE
STUDY PERIOD 86 thru 95

	ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS: FIRST COST: Convert To Annual AMOUNT	CAPITAL REQUIREMENTS: PRESENT WORTH OF FIRST COST: DATE OF EXPEND.	FACTOR	Annual AMOUNT	REVENUE REQUIREMENTS: ANNUAL COST: PER CENT	ANNUAL COST: AMOUNT	PRESENT WORTH OF ANNUAL COSTS: PERIOD	FACTOR	AMOUNT
1	Helena - Missoula Ckts	48	224	x 12.564	86		135,088			10	6.144	829,981
2	" "	4	336	x 12.564	92		16,886			10-6	1.789	30,209
3												
4												
5	Ckt cost addition 7%/year	48	15.68	x 12.564	87		9,456			10-1	5.235	49,502
6			16.78		88		10,120			10-2	4.408	44,609
7			17.95		89		10,825			10-3	3.657	39,587
8			19.21		90		11,826			10-4	2.974	35,170
9		↓	20.55		91		12,393			10-5	2.353	29,161
10		52	21.97		92		14,354			10-6	1.789	25,679
11			23.53		93		15,373			10-7	1.276	19,616
12			25.18		94		16,451			10-8	.809	13,309
13		↓	26.94	↓	95		17,601			10-9	.385	6,776
14												1,123,599
15												
16	One Time Installation Chg	20	577		86	1	11,540					11,540
17		4	577		92	.5645	1,303					1,303
18												
19	Total											
20												1,136,442

REMARKS:
Deducted existing ckts from one time charge quantity

	NON-STANDARD ANNUAL COST PERCENTAGES (1)	(2)	(3)	(4)	(5)
TYPE OF PLANT					
C OF M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL %					

ECONOMIC SELECTION STUDY

DESCRIPTION: Helena - Missoula Telecommunications Route
Microwave Radio and T1 Channel Banks

PLAN 2 OF 3 SHEET 1 OF 3
PREP. BY [illegible] DATE
STUDY PERIOD 86 thru 95

	ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS: FIRST COST AMOUNT	PRESENT WORTH OF FIRST COST: DATE OF EXPEND.	PRESENT WORTH OF FIRST COST: FACTOR	PRESENT WORTH OF FIRST COST: AMOUNT	REVENUE REQUIREMENTS: ANNUAL COST PER CENT	ANNUAL COST AMOUNT	PRESENT WORTH OF ANNUAL COSTS: PERIOD	PRESENT WORTH OF ANNUAL COSTS: FACTOR	PRESENT WORTH OF ANNUAL COSTS: AMOUNT
1	Microwave Radio Equip											
2	Terminal Site Complete	1	135,500	135,500	86	1.0	135,500	Pg.3	30,198	10	6.144	185,532
3	Remote Repeater, Comp.	3	277,400	832,200	86	1.0	832,200	Pg.2	187,149	10	6.144	1149,843
4	Terminal Site Partial	1	63,900	63,900	86	1.0	63,900	Pg.3	14,505	10	6.144	89,119
5	Total			1,031,600			1,031,600		231,852			1,424,499
6	Deduct for 9ch radio	8	9,000	(72,000)	86	1.0	(72,000)	22.7	(16,344)	10	6.144	(100,418)
7	Total			959,600			959,600		215,508			1,324,081
8												
9	Channel Bank Comm Equip	4	6000	24,000	86	1.0	24,000	22.7	5,448	10	6.144	33473
10	Channel Units	96	260	24,960	86	1.0	24,960	22.7	5,666	10	6.144	34,812
11	Total						1,008,560		226,662			1,392,366
12												
13												
14	Channel Bank Comm Eq	2	6000	12,000	92	.5645	6,774	22.7	2,724	10-6	1.789	4,873
15	Channel Units	8	260	2,080	92	.5645	1,174	22.7	472	10-6	1.789	844
16												
17	Add to MW Radio Equip											
18	Repeater Site Partial	1	127,800	127,800	86	1.0	127,800	22.7	29,011	10	6.144	178,244
19	Deduct for 9ch radio	2	9,000	(18,000)	86	1.0	(18,000)	22.7	(4,086)	10	6.144	(25,104)
20	Total											1,551,223

REMARKS:

	NON-STANDARD ANNUAL COST PERCENTAGES (1)	(2)	(3)	(4)	(5)
TYPE OF PLANT					
C OF M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL %					

ECONOMIC SELECTION STUDY

DESCRIPTION: Helena - Missoula Telecommunications Route
Microwave Radio Repeater Sites Unit Costs

PLAN 2 OF 3 SHEET 2 OF 3
PREP. BY m DATE
STUDY PERIOD 86 Thru 95

	ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS: FIRST COST AMOUNT	PRESENT WORTH OF FIRST COST: DATE OF EXPEND.	PRESENT WORTH OF FIRST COST: FACTOR	PRESENT WORTH OF FIRST COST: AMOUNT	REVENUE REQUIREMENTS: ANNUAL COST PER CENT	ANNUAL COST AMOUNT	PRESENT WORTH OF ANNUAL COSTS: PERIOD	PRESENT WORTH OF ANNUAL COSTS: FACTOR	PRESENT WORTH OF ANNUAL COSTS: AMOUNT
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11	Remote Repeaters											
12	Spares, Each Site	1 Lot	10,000	10,000								
13	Digital Microwave Radio	2	50,400	100,800				22.7	2,270			13,947
14	Antenna System	2	9,000	18,000				22.7	22,882			140,587
15	Battery and Power	1	5,600	5,600				22.7	4,086			25,104
16	AC Generator	1	35,000	35,000				22.7	1,271			7,809
17	Tower, 150 Ft.	1	62,000	62,000				21.7	7,595			46,664
18	Land And Site Work	1	30,000	30,000				21.7	13,454			82,661
19	Building	1	25,000	25,000				18.0	5,400			33,178
20	Total			286,400				21.7	5,425			33,331
									62383			383,281

REMARKS:

	NON-STANDARD ANNUAL COST PERCENTAGES (1)	(2)	(3)	(4)	(5)
TYPE OF PLANT	MW+MUX	Towers	Buildings	Land	A.C. Gen.
C OF M	10	10	10	10	10
PROPERTY TAX	0	0	0	0	0
INCOME TAX	0	0	0	0	0
DEPRECIATION	6.7	6.7	6.7	0	6.7
MAINTENANCE	6	5	5	8	5
TOTAL %	22.7	21.7	21.7	18.0	21.7

ECONOMIC SELECTION STUDY

DESCRIPTION: Helena - Missoula Telecommunications Route
Microwave Radio Terminal Site Unit Costs

PLAN 2 OF 3 SHEET 3 OF 3
PREP. BY [illegible] DATE
STUDY PERIOD 86 thru 95

	ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS: FIRST COST AMOUNT	PRESENT WORTH OF FIRST COST: DATE OF EXPEND.	FACTOR	AMOUNT	REVENUE REQUIREMENTS: ANNUAL COST PER CENT	ANNUAL COST AMOUNT	PRESENT WORTH OF ANNUAL COSTS: PERIOD	FACTOR	AMOUNT
	Complete Term. Site											
1	Digital Microwave Radio	1	54,900	54,900	86	1.0		22.7	12,462	10	6.144	76,567
2	Antenna System	1	9,000	9,000				22.7	2,043			12,552
3	Battery and Power	1	5,600	5,600				22.7	1,271			7,809
4	AC Generator	1	35,000	35,000				21.7	7,595			46,664
5	Tower, Stub, 30 Ft.	1	16,000	16,000				21.7	3,472			21,332
6	Site Work, Existing Bldg.	1 Lot	5,000	5,000				21.7	1,085			6,666
7	Total			125,500								
8	Spares, Each Site	1 Lot	10,000	10,000				22.7	2,270			13,947
9	Total			135,500					30,198			185,537
10												
11												
12	Partial Term. Site											
13	Digital Microwave Radio	1	54,900		86	1.0		22.7	12,462	10	6.144	76,567
14	Antenna System	1	9,000		"	"		22.7	2,043			12,552
15	Total		63,900						14,505			89,119
16												
17	Partial Repeater Site											
18	Digital Microwave Radio	2	54,900	109,800	86	1.0		22.7				
19	Antenna System	2	9,000	18,000	"	"		22.7				
20				127,800					29,011	10	6.144	178,241

REMARKS:

	NON-STANDARD ANNUAL COST PERCENTAGES (1)	(2)	(3)	(4)	(5)
TYPE OF PLANT					
C OF M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL %					

SECTION 3

HELENA-GREAT FALLS

TELECOMMUNICATIONS ROUTE STUDY

Three plans are compared in the analysis of the Helena-Great Falls route as follows:

1. Conventional circuits as used at present

2. Microwave radio with T1 channel banks, all facilities are State owned. The terminal at Helena and the first repeater have reduced costs because it is assumed that they have been installed for other routes.

3. T1 circuits. The transmission medium would be owned by a common carrier and the channel banks would be State owned.

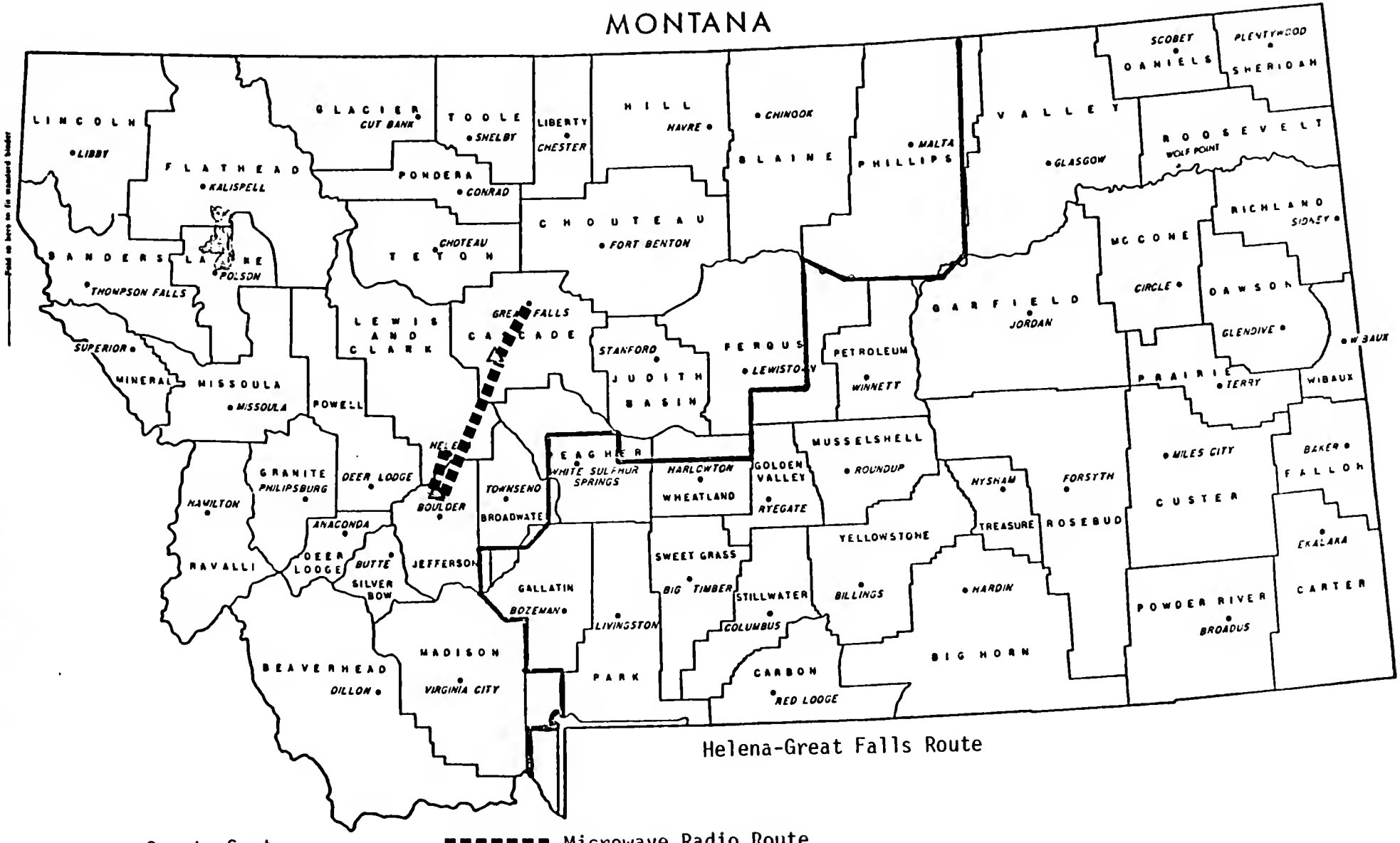
The map illustrates the physical routing of the microwave system.

The economic selection study work sheets for each plan include the quantities and costs of all facilities, the annual charges and the calculations.

Summary of Results

	Present Worth of Annual Costs	Description
Plan 1	$ 681,203	Conventional circuits
Plan 2	820,450	Microwave Radio
Plan 3	482,696	T1 Circuits

The results indicate that T1 is clearly the most cost effective method of providing circuits in this route for the quantities of circuits used in the analysis. The cost relationships for 1986 are illustrated in the annual costs per circuit graph. Note also that the conventional circuits would increase in cost at a compounded rate of 7% per year, while the other methods of providing circuits would remain relatively constant.



Helena-Great Falls Route

• County Seat

△ Repeater

■■■■■■ Microwave Radio Route

HELENA-GREAT FALLS ROUTE CIRCUIT REQUIREMENTS

	86	88	90	92	94	96
Helena-Great Falls, 20 voice, 3 data	24	25	26	27	28	29
Helena-Havre, 8 voice	8	9	9	9	10	10
Adjustment for rounding	1	0	0	1	0	1
TOTAL	33	34	35	37	38	40

5% added to 1986 requirements to account for estimated overflow to discounted toll on the present system.

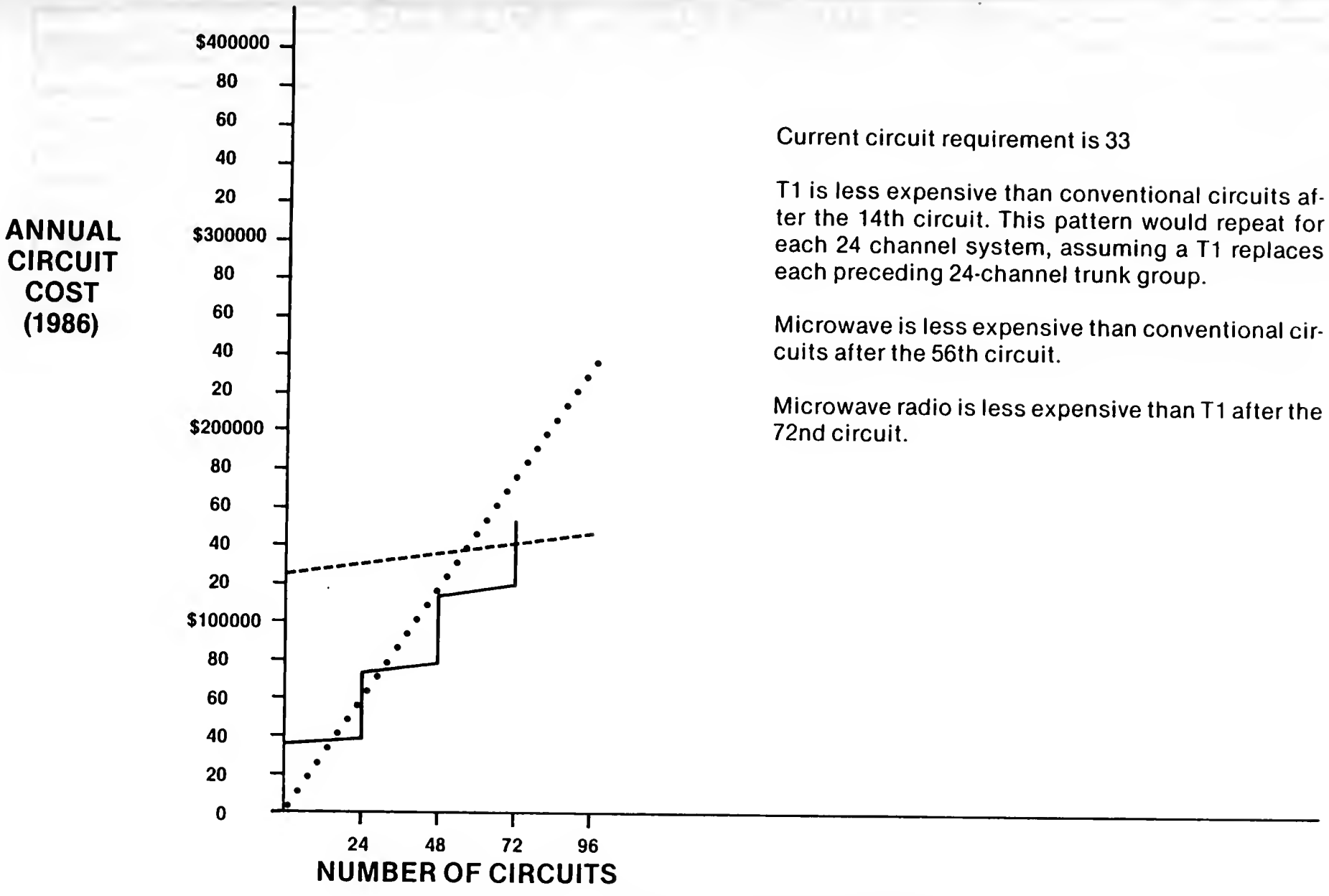
Growth estimated at approximately 2% per year.

Cost of Telco circuits increased at 7% per year.

The growth is less than would require a third channel bank so 36 circuits are used to represent the total. Small additions or reductions would not change the results within the acceptable level of accuracy.

The radios on this route are 96 channel capacity.

One repeater site would be in place if the Helena-Bozeman route was installed. Helena terminal and the repeater site costs reflect the equipment added for this route.



Current circuit requirement is 33

T1 is less expensive than conventional circuits after the 14th circuit. This pattern would repeat for each 24 channel system, assuming a T1 replaces each preceding 24-channel trunk group.

Microwave is less expensive than conventional circuits after the 56th circuit.

Microwave radio is less expensive than T1 after the 72nd circuit.

HELENA — GREAT FALLS ROUTE

---------- **Microwave Radio**

———— **T1**

• • • • • • • • • **Conventional Circuits**

ECONOMIC SELECTION STUDY

DESCRIPTION: Helena - Great Falls Telecommunications Route
Conventional Circuits

PLAN 1 OF 3 SHEET 1 OF 1
PREP. BY m DATE
STUDY PERIOD 86 thru 95

	ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS: FIRST COST — Convert To Annual	PRESENT WORTH OF FIRST COST: DATE OF EXPEND.	FACTOR	Annual AMOUNT	REVENUE REQUIREMENTS: ANNUAL COST PER CENT	ANNUAL COST AMOUNT	PRESENT WORTH OF ANNUAL COSTS: PERIOD	FACTOR	AMOUNT
1	Helena - Great Falls Ckts	36	185	X 12.564	86		83,676			10	6.144	514,105
2												
3												
4												
5	ckt Cost Additions 7%/yr	36	12.95	X 12.564	87		5857			10-1	5.232	30,644
6			13.86		88		6269			10-2	4.408	27,634
7			14.81		89		6703			10-3	3.657	24,513
8			15.87		90		7178			10-4	2.974	21,347
9			16.97		91		7676			10-5	2.353	18,062
10			18.17		92		8218			10-6	1.789	14,702
11			19.43		93		8788			10-7	1.276	11,213
12			20.79		94		9403			10-8	.809	7,607
13		↓	22.25	↓	95		10064			10-9	.385	3,875
14												
15	One time installation chg	13	577		86	1	7501					7,501
16												
17	Total											681,203
18												
19												
20												

REMARKS:
Deducted existing circuits from one time charge quantity.

	NON-STANDARD ANNUAL COST PERCENTAGES (1)	(2)	(3)	(4)	(5)
TYPE OF PLANT					
C OF M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL %					

ECONOMIC SELECTION STUDY

DESCRIPTION: Helena - Great Falls Telecommunications Route
Microwave Radio And T1 Channel Banks

PLAN 2 OF 3 SHEET 1 OF 3
PREP. BY [illegible] DATE
STUDY PERIOD 86 thru 95

	ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS: FIRST COST AMOUNT	CAPITAL REQUIREMENTS: PRESENT WORTH OF FIRST COST DATE OF EXPEND.	CAPITAL REQUIREMENTS: PRESENT WORTH OF FIRST COST FACTOR	CAPITAL REQUIREMENTS: PRESENT WORTH OF FIRST COST AMOUNT	REVENUE REQUIREMENTS: ANNUAL COST PER CENT	REVENUE REQUIREMENTS: ANNUAL COST AMOUNT	REVENUE REQUIREMENTS: PRESENT WORTH OF ANNUAL COSTS PERIOD	REVENUE REQUIREMENTS: PRESENT WORTH OF ANNUAL COSTS FACTOR	REVENUE REQUIREMENTS: PRESENT WORTH OF ANNUAL COSTS AMOUNT
1	Microwave Radio Equip											
2	Terminal Site Complete	1	135,500	135,500	86	1.0		Pg. 3	30,198	10	6.144	185,537
3	Remote Repeater Comp.	1	286,400	286,400	86	1.0		Pg. 2	62,383			383,281
4	Terminal Site Partial	1	63,900	63,900	86	1.0		22.7	14,505			89,119
5	Remote Repeater Partial	1	127,800	127,800	86	1.0		22.7	29,011			178,244
6	Deduct for 96 Ch Radios	6	9,000	(54,000)	86	1.0		22.7	(12,258)			(75,313)
7									123,839			760,868
8												
9												
10	Channel Bank Comm. Equip	4	6000	24,000	86			22.7	5,448	10	6.144	33,473
11	Channel Units	72	260	18,720	86			22.7	4,249	10	6.144	26,109
12	Total											820,450
13												
14												
15												
16												
17												
18												
19												
20												

REMARKS:

	NON-STANDARD ANNUAL COST PERCENTAGES (1)	(2)	(3)	(4)	(5)
TYPE OF PLANT					
C OF M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL %					

ECONOMIC SELECTION STUDY

DESCRIPTION: Helena - Great Falls Telecommunications Route
Microwave Radio Repeater Sites

PLAN 2 OF 3 SHEET 2 OF 3
PREP. BY m DATE
STUDY PERIOD 86 Thru 95

	ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS: FIRST COST AMOUNT	PRESENT WORTH OF FIRST COST: DATE OF EXPEND.	PRESENT WORTH OF FIRST COST: FACTOR	PRESENT WORTH OF FIRST COST: AMOUNT	REVENUE REQUIREMENTS: ANNUAL COST PER CENT	ANNUAL COST AMOUNT	PRESENT WORTH OF ANNUAL COSTS: PERIOD	PRESENT WORTH OF ANNUAL COSTS: FACTOR	PRESENT WORTH OF ANNUAL COSTS: AMOUNT
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11	Remote Repeaters											
12	Spares, Each Site	1 Lot	10,000	10,000								
13	Digital Microwave Radio	2	50,400	100,800				22.7	2,270			13,947
14	Antenna System	2	9,000	18,000				22.7	22,882			140,587
15	Battery and Power	1	5,600	5,600				22.7	4,086			25,104
16	AC Generator	1	35,000	35,000				22.7	1,271			7,809
17	Tower, 150 Ft.	1	62,000	62,000				21.7	7,595			46,664
18	Land And Site Work	1	30,000	30,000				21.7	13,454			82,661
19	Building	1	25,200	25,000				18.0	5,400			33,179
20	Total			286,400				21.7	5425			33,331
									62383			383,281

REMARKS:

NON-STANDARD ANNUAL COST PERCENTAGES	(1)	(2)	(3)	(4)	(5)
TYPE OF PLANT	MW+MUX	Towers	Buildings	Land	A.C. Gen.
C OF M	10	10	10	10	10
PROPERTY TAX	0	0	0	0	0
INCOME TAX	0	0	0	0	0
DEPRECIATION	6.7	6.7	6.7	0	6.7
MAINTENANCE	6	5	5	8	5
TOTAL %	22.7	21.7	21.7	18.0	21.7

ECONOMIC SELECTION STUDY

DESCRIPTION: Helena - Great Falls Telecommunications Route
Microwave Radio Terminal Site

PLAN 2 OF 3 SHEET 3 OF 3
PREP. BY M DATE
STUDY PERIOD 86 thru 95

	ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS: FIRST COST AMOUNT	PRESENT WORTH OF FIRST COST: DATE OF EXPEND.	FACTOR	AMOUNT	REVENUE REQUIREMENTS: ANNUAL COST PER CENT	AMOUNT	PRESENT WORTH OF ANNUAL COSTS: PERIOD	FACTOR	AMOUNT
	Complete Term. Sit.											
1	Digital Microwave Radio	1	54,900	54,900	86	1.0		22.7	12,462	10	6.144	76,567
2	Antenna System	1	9,000	9,000				22.7	2,043			12,552
3	Battery and Power	1	5,600	5,600				22.7	1,271			7,809
4	AC Generator	1	35,000	35,000				21.7	7,595			46,664
5	Tower, Stub, 30 Ft.	1	16,000	16,000				21.7	3,472			21,332
6	Site Work, Existing Bldg.	1 Lot	5,000	5,000				21.7	1,085			6,666
7	Total			125,500								
8	Spares, Each Site	1 Lot	10,000	10,000				22.7	2,270			13,947
9	Total			135,500					30,198			185,537
10												
11												
12	Partial Term. Site											
13	Digital Microwave Radio	1	54,900		86	1.0		22.7	12,462	10	6.144	76,567
14	Antenna System	1	9,000		"	"		22.7	2,043			12,552
15	Total		63,900						14,505			89,119
16												
17	Partial Repeater Sit.											
18	Digital Microwave Radio	2	54,400	109,800	86	1.0		22.7				
19	Antenna System	2	9,000	18,000	"	"		22.7				
20				127,800					29,011	10	6.144	178,241

REMARKS:

	NON-STANDARD ANNUAL COST PERCENTAGES (1)	(2)	(3)	(4)	(5)
TYPE OF PLANT					
C OF M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL %					

ECONOMIC SELECTION STUDY

DESCRIPTION: Helena - Great Falls Telecommunications Route
T1 Circuits

PLAN 3 OF 3 SHEET 1 OF 1
PREP. BY m DATE
STUDY PERIOD 86 Thru 95

	ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS: FIRST COST AMOUNT	PRESENT WORTH OF FIRST COST: DATE OF EXPEND.	PRESENT WORTH OF FIRST COST: FACTOR	PRESENT WORTH OF FIRST COST: AMOUNT	REVENUE REQUIREMENTS: ANNUAL COST PER CENT	ANNUAL COST AMOUNT	PRESENT WORTH OF ANNUAL COSTS: PERIOD	PRESENT WORTH OF ANNUAL COSTS: FACTOR	PRESENT WORTH OF ANNUAL COSTS: AMOUNT
1	Channel Bank Comm Equip	4	6000	24,000	86			22.7	5,448	10	6.144	33,473
2	Channel Units	72	260	18,720	86			22.7	4,249	10	6.144	26,109
3												
4			Monthly Charge	Factor To Conv To Annual								
5	T1 Facility	2	2716	X 12.564	86				68,248	10	6.144	419,314
6												
7												
8												
9												
10	1 Time Charge 1st CKT.	1	2100		86	1.0						2,100
11	1 Time Charge Subs CKT.	1	1700		86	1.0						1,700
12	Total											482,696
13												
14												
15												
16												
17												
18												
19												
20												

REMARKS:
T1 Costs are from common carrier based on 5 year contract.

	NON-STANDARD ANNUAL COST PERCENTAGES (1)	(2)	(3)	(4)	(5)
TYPE OF PLANT					
C OF M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL %					

SECTION 4

BILLINGS-BOZEMAN

TELECOMMUNICATIONS ROUTE STUDY

Three plans are compared in the analysis of the Bozeman-Billings route as follows:

1. Conventional circuits as used at present

2. Microwave radio with T1 channel banks, all facilities are State owned. The terminal at Bozeman has been reduced in cost because it is assumed that the support work had been accomplished for the Helena-Bozeman route. Livingston, Big Timber, and Columbus are repeater points and could have access to the network at a small additional expense not included in these costs. If considered desirable, this drop and insert capability should be provided when the system is first constructed.

3. T1 circuits. The transmission medium would be owned by a common carrier and the channel banks would be State owned.

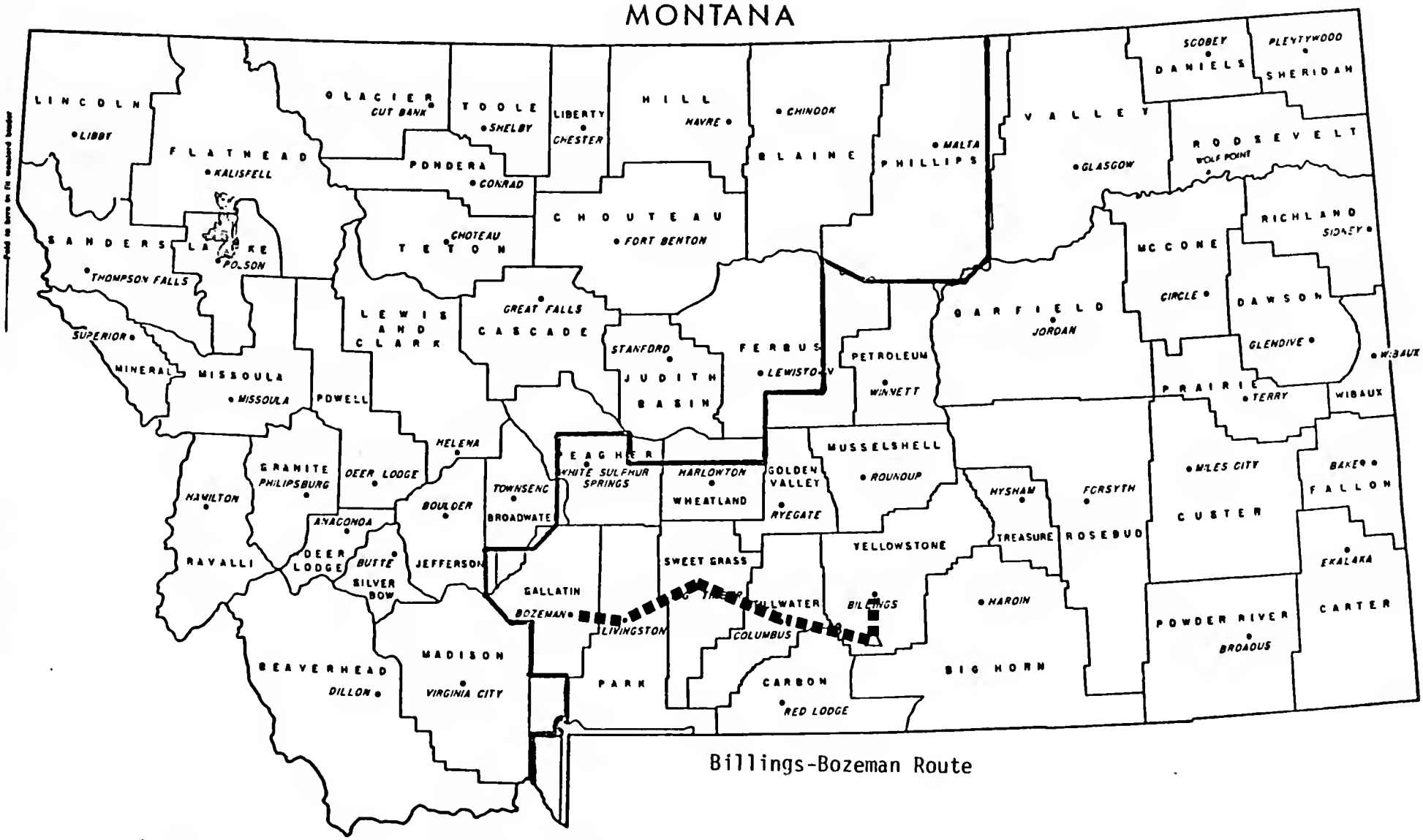
The map illustrates the physical routing of the microwave system.

The economic selection study work sheets for each plan include the quantities and costs of all facilities, the annual charges and the calculations.

Summary of Results

	Present Worth of Annual Costs	Description
Plan 1	$1,155,191	Conventional circuits
Plan 2	1,382,675	Microwave Radio
Plan 3	716,157	T1 Circuits

The results indicate that T1 is clearly the most cost effective method of providing circuits in this route for the quantities of circuits used in the analysis. The cost relationships for 1986 are illustrated in the annual costs per circuit graph. Note also that the conventional circuits would increase in cost at a compounded rate of 7% per year, while the other methods of providing circuits would remain relatively constant.


MONTANA
LINCOLN
LIBBY
FLATHEAD
KALISPELL
GLACIER
CUT BANK
TOOLE
SHELBY
LIBERTY
CHESTER
HILL
HAVRE
CHINOOK
BLAINE
MALTA
PHILLIPS
VALLEY
GLASGOW
SCOBEY
DANIELS
PLENTYWOOD
SHERIDAN
ROOSEVELT
WOLF POINT
PONDERA
CONRAD
CHOUTEAU
FORT BENTON
TETON
CHOTEAU
SANDERS
LAKE
POLSON
THOMPSON FALLS
RICHLAND
SIDNEY
MCCONE
CIRCLE
GARFIELD
JORDAN
DAWSON
GLENDIVE
WIBAUX
PRAIRIE
TERRY
GREAT FALLS
CASCADE
LEWIS AND CLARK
STANFORD
JUDITH BASIN
FERGUS
LEWISTOWN
PETROLEUM
WINNETT
SUPERIOR
MINERAL
MISSOULA
POWELL
HELENA
MUSSELSHELL
ROUNDUP
GRANITE
PHILIPSBURG
DEER LODGE
TOWNSEND
BROADWATER
BOULDER
JEFFERSON
BUTTE
SILVER BOW
ANACONDA
DEER LODGE
RAVALLI
HAMILTON
MILES CITY
CUSTER
FALLON
BAKER
MYSHAM
FORSYTH
ROSEBUD
TREASURE
YELLOWSTONE
SWEET GRASS
GALLATIN
BOZEMAN
LIVINGSTON
COLUMBUS
BILLINGS
HARDIN
BIG HORN
POWDER RIVER
BROADUS
CARTER
EKALAKA
MADISON
VIRGINIA CITY
BEAVERHEAD
DILLON
PARK
CARBON
RED LODGE
Billings-Bozeman Route
County Seat
Microwave Radio Route
Repeater

BILLINGS-BOZEMAN ROUTE CIRCUITS REQUIREMENTS

	86	88	90	92	94	96
Billings-Helena, 22 voice, 3 data	27	28	28	30	30	31
Billings-Bozeman, 6 voice	6	6	7	7	7	7
Billings-Missoula, 6 voice	6	6	7	7	7	7
Adjustment for rounding	0	0	0	0	2	2
TOTAL	39	40	42	44	46	47

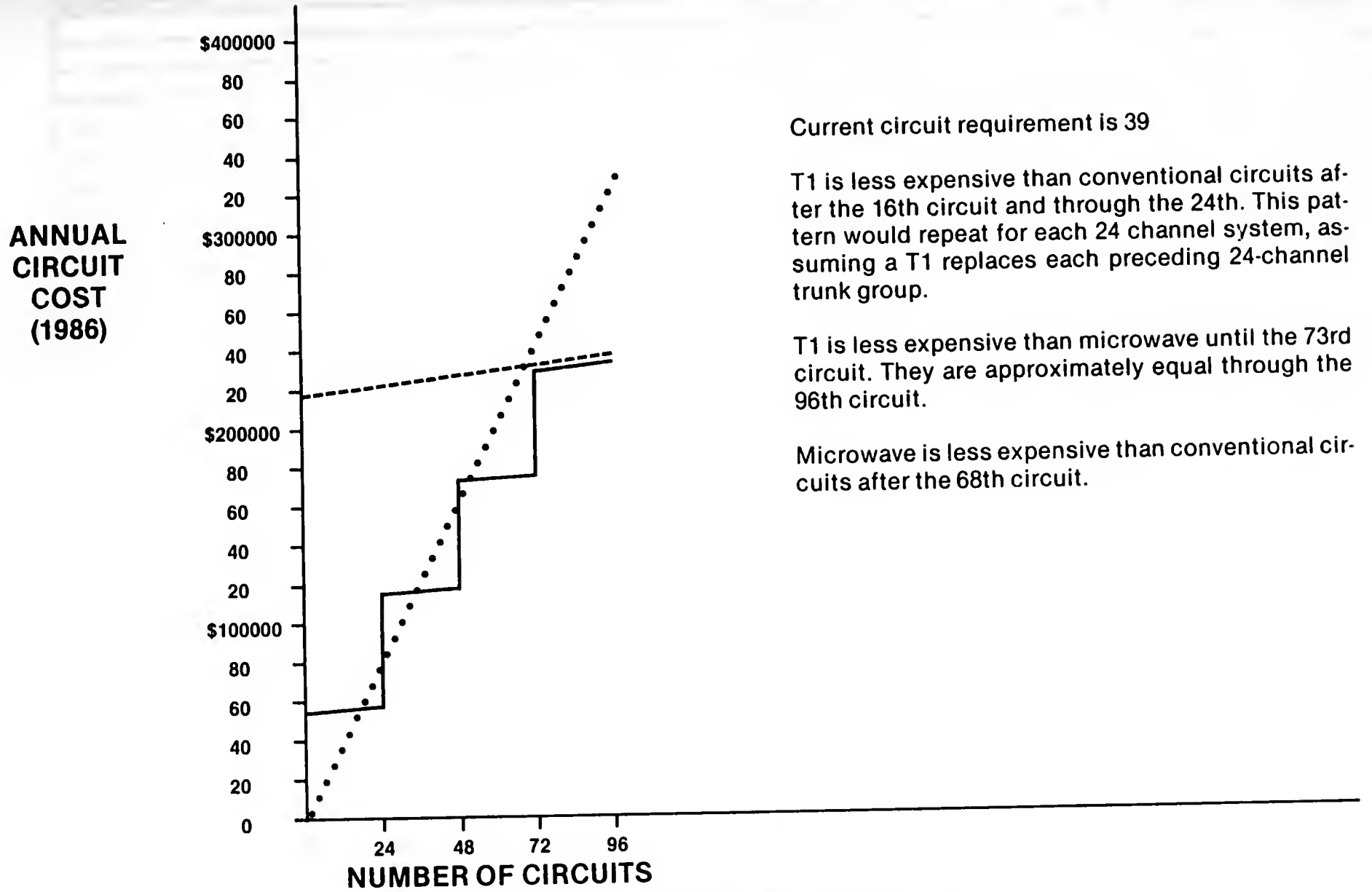
5% added to 1986 requirements to account for estimated overflow to discounted toll.

Growth estimated at approximately 2% per year.

Cost of Telco circuits increased at 7% per year.

As the growth is small, 42 circuits are used to represent the nominal requirement for the study period. Small additions or reductions would not change the results within the acceptable level of accuracy. The growth through the study period does not require additional T1 common equipment.

The Bozeman terminal site is assumed to have been installed for the Helena-Bozeman route. The costs for the equipment was reduced accordingly.



Current circuit requirement is 39

T1 is less expensive than conventional circuits after the 16th circuit and through the 24th. This pattern would repeat for each 24 channel system, assuming a T1 replaces each preceding 24-channel trunk group.

T1 is less expensive than microwave until the 73rd circuit. They are approximately equal through the 96th circuit.

Microwave is less expensive than conventional circuits after the 68th circuit.

BILLINGS — BOZEMAN ROUTE

---------- Microwave Radio

———— T1

• • • • • • • • • Conventional Circuits

ECONOMIC SELECTION STUDY

DESCRIPTION: Billings - Bozeman Telecommunications Route
Conventional Circuits

PLAN 1 OF 3 SHEET 1 OF 1
PREP. BY m DATE
STUDY PERIOD 86 thru 95

	ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS: FIRST COST (Convert to Annual)	PRESENT WORTH OF FIRST COST: DATE OF EXPEND.	FACTOR	AMOUNT	REVENUE REQUIREMENTS: ANNUAL COST PER CENT	ANNUAL COST AMOUNT	PRESENT WORTH OF ANNUAL COSTS: PERIOD	FACTOR	AMOUNT
1	Billings - Bozeman Ckts.	42	267	x 12.564	86				140,843	10	6.144	865,647
2												
3												
4												
5	Ckt Cost Additions	42	18.69	x 12.564	87				9,862	10-1	5.335	51,628
6			20.00		88				10,554	10-2	4.408	46,522
7			21.40		89				11,293	10-3	3.657	41,299
8			22.90		90				12,084	10-4	2.924	35,338
9			24.50		91				12,928	10-5	2.353	30,420
10			26.21		92				13,831	10-6	1.789	24,744
11			28.05		93				14,802	10-7	1.276	18,887
12			30.01		94				15,836	10-8	.809	12,811
13			32.11		95				16,944	10-9	.385	6,523
14												1,134,419
15												
16	One Time Installation Chg.	36	577		86	1.0						20,772
17												
18	Total											1,155,191
19												
20												

REMARKS:

	NON-STANDARD ANNUAL COST PERCENTAGES (1)	(2)	(3)	(4)	(5)
TYPE OF PLANT					
C OF M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL %					

ECONOMIC SELECTION STUDY

DESCRIPTION: Billings - Bozeman Telecommunications Route
Microwave Radio And T1 Channel Banks

PLAN 2 OF 3 SHEET 1 OF 3
PREP. BY M DATE
STUDY PERIOD 86 thru 95

	ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS: FIRST COST AMOUNT	CAPITAL REQUIREMENTS: PRESENT WORTH OF FIRST COST DATE OF EXPEND.	CAPITAL REQUIREMENTS: PRESENT WORTH OF FIRST COST FACTOR	CAPITAL REQUIREMENTS: PRESENT WORTH OF FIRST COST AMOUNT	REVENUE REQUIREMENTS: ANNUAL COST PER CENT	REVENUE REQUIREMENTS: ANNUAL COST AMOUNT	REVENUE REQUIREMENTS: PRESENT WORTH OF ANNUAL COSTS PERIOD	REVENUE REQUIREMENTS: PRESENT WORTH OF ANNUAL COSTS FACTOR	REVENUE REQUIREMENTS: PRESENT WORTH OF ANNUAL COSTS AMOUNT
1	Channel Bank Comm. Equip	4	6000	24,000	86	1.0						
2	Channel Units	84	260	21,840	86	1.0						
3												
4	Total			45,840				22.7	10,406	10	6.144	63,932
5												
6	Microwave Radio Equip											
7	Terminal Site Complete	1	135,500	135,500	86	1.0		Pg 3	30,198	10	6.144	185,537
8	Terminal Site Partial	1	63,900	63,900	86	1.0		Pg 3	14,505	10	6.144	89,119
9	County Seat Rptr.	3	190,400	571,200	86	1.0		Pg 2	127,983	10	6.144	786,328
10	Remote Repeater	1	277,400	286,400	86	1.0		Pg 2	62,383	10	6.144	383,281
11	Total			1,102,840								
12	Deduct for 96ch radio	10	9000	(90,000)	86	1.0		22.7	(20,430)	10	6.144	(125,522)
13	Total			1,012,840								1,383,675
14												
15												
16												
17												
18												
19												
20												

REMARKS:

	NON-STANDARD ANNUAL COST PERCENTAGES (1)	(2)	(3)	(4)	(5)
TYPE OF PLANT					
C OF M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL %					

ECONOMIC SELECTION STUDY

DESCRIPTION: Billings - Bozeman Telecommunications Route
Microwave Radio Repeater Sites

PLAN 2 OF 3 SHEET 2 OF 3
PREP. BY M DATE
STUDY PERIOD 86 thru 95

	ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS: FIRST COST AMOUNT	PRESENT WORTH OF FIRST COST: DATE OF EXPEND.	PRESENT WORTH OF FIRST COST: FACTOR	PRESENT WORTH OF FIRST COST: AMOUNT	REVENUE REQUIREMENTS: ANNUAL COST PER CENT	ANNUAL COST AMOUNT	PRESENT WORTH OF ANNUAL COSTS: PERIOD	PRESENT WORTH OF ANNUAL COSTS: FACTOR	PRESENT WORTH OF ANNUAL COSTS: AMOUNT
1	County Seat Repeater											
2	Digital Microwave Radio	2	50,400	100,800	86	1.0		22.7	22882	10	6.144	140,587
3	Antenna System	2	9,000	18,000				22.7	4086			25,104
4	Battery and Power	1	5,600	5,600				22.7	1271			7,809
5	AC Generator	1	35,000	35,000				21.7	7595			46,664
6	Tower, Stub, 30 Ft.	1	16,000	16,000				21.7	3472			21,332
7	Site Work, Existing Bldg.	1 Lot	5,000	5,000				21.7	1085			6,666
8	Total			180,400								248,162
9	Spares, Each Site	1 Lot	10,000	10,000				22.7	2270			13,947
10	Total			190,400					42661			262,109
11	Remote Repeaters											
12	Spares, Each Site	1 Lot	10,000	10,000				22.7	2,270			13,947
13	Digital Microwave Radio	2	50,400	100,800				22.7	22,882			140,587
14	Antenna System	2	9,000	18,000				22.7	4,086			25,104
15	Battery and Power	1	5,600	5,600				22.7	1,271			7,809
16	AC Generator	1	35,000	35,000				21.7	7,595			46,664
17	Tower, 150 Ft.	1	62,000	62,000				21.7	13,454			82,661
18	Land And Site Work	1	30,000	30,000				18.0	5,400			33,178
19	Building	1	25,000	25,000				21.7	5425			33,331
20	Total			286,400					62383			383,281

REMARKS:

NON-STANDARD ANNUAL COST PERCENTAGES	(1)	(2)	(3)	(4)	(5)
TYPE OF PLANT	MW+MUX	Towers	Buildings	Land	A.C. Gen.
C OF M	10	10	10	10	10
PROPERTY TAX	0	0	0	0	0
INCOME TAX	0	0	0	0	0
DEPRECIATION	6.7	6.7	6.7	0	6.7
MAINTENANCE	6	5	5	8	5
TOTAL %	22.7	21.7	21.7	18.0	21.7

ECONOMIC SELECTION STUDY

DESCRIPTION: Billings - Bozeman Telecommunications Route
Microwave Radio Terminal Site Unit Costs

PLAN 2 OF 3 SHEET 3 OF 3
PREP. BY M DATE
STUDY PERIOD 86 thru 95

	ITEM Complete	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS: FIRST COST AMOUNT	PRESENT WORTH OF FIRST COST: DATE OF EXPEND.	PRESENT WORTH OF FIRST COST: FACTOR	PRESENT WORTH OF FIRST COST: AMOUNT	REVENUE REQUIREMENTS: ANNUAL COST PER CENT	ANNUAL COST AMOUNT	PRESENT WORTH OF ANNUAL COSTS: PERIOD	PRESENT WORTH OF ANNUAL COSTS: FACTOR	PRESENT WORTH OF ANNUAL COSTS: AMOUNT
1	Digital Microwave Radio	1	54,900	54,900	86	1.0		22.7	12,462	10	6.144	76,567
2	Antenna System	1	9,000	9,000				22.7	2,043			12,552
3	Battery and Power	1	5,600	5,600				22.7	1,271			7,809
4	AC Generator	1	35,000	35,000				21.7	7,595			46,664
5	Tower Stub, 30 Ft.	1	16,000	16,000				21.7	3,472			21,332
6	Site Work, Existing Bldg.	1 Lot	5,000	5,000				21.7	1,085			6,666
7	Total			125,500								
8	Spares, Each Site	1 Lot	10,000	10,000				22.7	2,270			13,947
9	Total			135,500					30,198			185,537
10												
11												
12	Partial											
13	Digital Microwave Radio	1	54,900		86	1.0		22.7	12,462	10	6.144	76,567
14	Antenna System	1	9,000		"	"		22.7	2,043			12,552
15	Total		63,900						14,505			89,119
16												
17												
18												
19												
20												

REMARKS:

NON-STANDARD ANNUAL COST PERCENTAGES

	(1)	(2)	(3)	(4)	(5)
TYPE OF PLANT					
O OF M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL %					

ECONOMIC SELECTION STUDY

DESCRIPTION: Billings - Bozeman Telecommunications Route
T1 Circuits

PLAN 3 OF 3 SHEET 1 OF 1
PREP. BY _____ DATE _____
STUDY PERIOD _____

	ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS: FIRST COST AMOUNT	CAPITAL REQUIREMENTS: PRESENT WORTH OF FIRST COST DATE OF EXPEND.	CAPITAL REQUIREMENTS: PRESENT WORTH OF FIRST COST FACTOR	CAPITAL REQUIREMENTS: PRESENT WORTH OF FIRST COST AMOUNT	REVENUE REQUIREMENTS: ANNUAL COST PER CENT	REVENUE REQUIREMENTS: ANNUAL COST AMOUNT	REVENUE REQUIREMENTS: PRESENT WORTH OF ANNUAL COSTS PERIOD	REVENUE REQUIREMENTS: PRESENT WORTH OF ANNUAL COSTS FACTOR	REVENUE REQUIREMENTS: PRESENT WORTH OF ANNUAL COSTS AMOUNT
1	Channel Bank & Ch. Equip	4/84	6000/260	45,840	86	1.0	45,840	22.7	10,406	10	6.144	63,932
2												
3												
4			Monthly Charge	Factor To Convert To Ann.								
5	T1 Facility	2	4200	x 12.564					105,538	10	6.144	648,425
6												
7												
8	1 time Charge 1st CKt.	1	2100		86	1.0						2,100
9	" " Subsequent	1	1700		86	1.0						1,700
10												
11												
12	Total											
13												716,157
14												
15												
16												
17												
18												
19												
20												

REMARKS:
T1 Costs are for 5 year contract

	NON-STANDARD ANNUAL COST PERCENTAGES (1)	(2)	(3)	(4)	(5)
TYPE OF PLANT					
C OF M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL %					

SECTION 5

HELENA-BUTTE

TELECOMMUNICATIONS ROUTE STUDY

Three plans are compared in the analysis of the Helena-Butte route as follows:

1. Conventional circuits as used at present

2. Microwave radio with T1 channel banks, all facilities are State owned. The microwave radio route is assumed to be in place from Helena to the third repeater for the Helena-Bozeman route. A cost is added for the drop and insert capability at the third repeater and a new radio and antenna system is installed there for the new route extending west to Butte. The initial Helena-Bozeman radios have ample capacity to add these requirements. A complete repeater site is required before Butte and a complete terminal site is required at Butte. Channel banks are installed at Helena and at Butte.

3. T1 circuits. The transmission medium would be owned by a common carrier and the channel banks would be State owned.

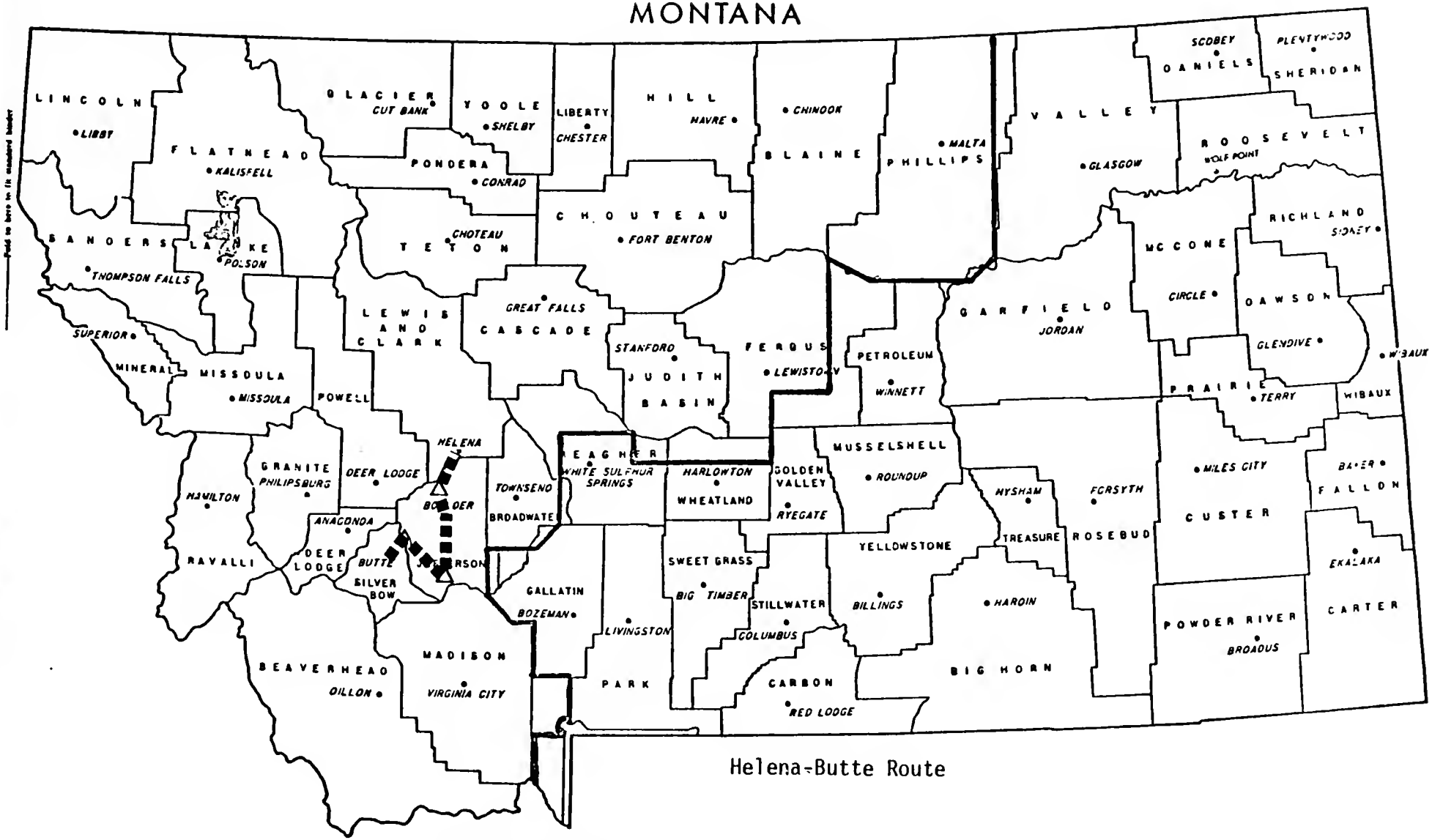
The map illustrates the physical routing of the microwave system.

The economic selection study work sheets for each plan include the quantities and costs for all facilities, the annual charges and the calculations.

Summary of Results

	Present Worth of Annual Costs	Description
Plan 1	$ 315,736	Conventional circuits
Plan 2	652,9475	Microwave Radio
Plan 3	187,526	T1 Circuits

The results indicate that T1 is clearly more economical for circuit requirements greater than 16 on the route at the present rates. T1 is significantly more cost effective than conventional circuits over the life of the study, but savings are not projected in the initial year. As these results are borderline but not conclusive at this time, it is recommended that the route be included in the request for proposal for T1 circuits. The results of the proposal could determine the decision to continue with conventional circuits or change to T1. Any increase in conventional circuit costs would tend to prove in T1 as would a requirement for 56 Kbps data and an increase in the circuit requirements.



Helena-Butte Route

• County Seat

△ Repeater

■■■■■■■■ Microwave Radio Route

HELENA-BUTTE ROUTE CIRCUITS REQUIREMENTS

	86	88	90	92	94	96
Helena-Butte, 15 voice	19	20	21	21	22	23

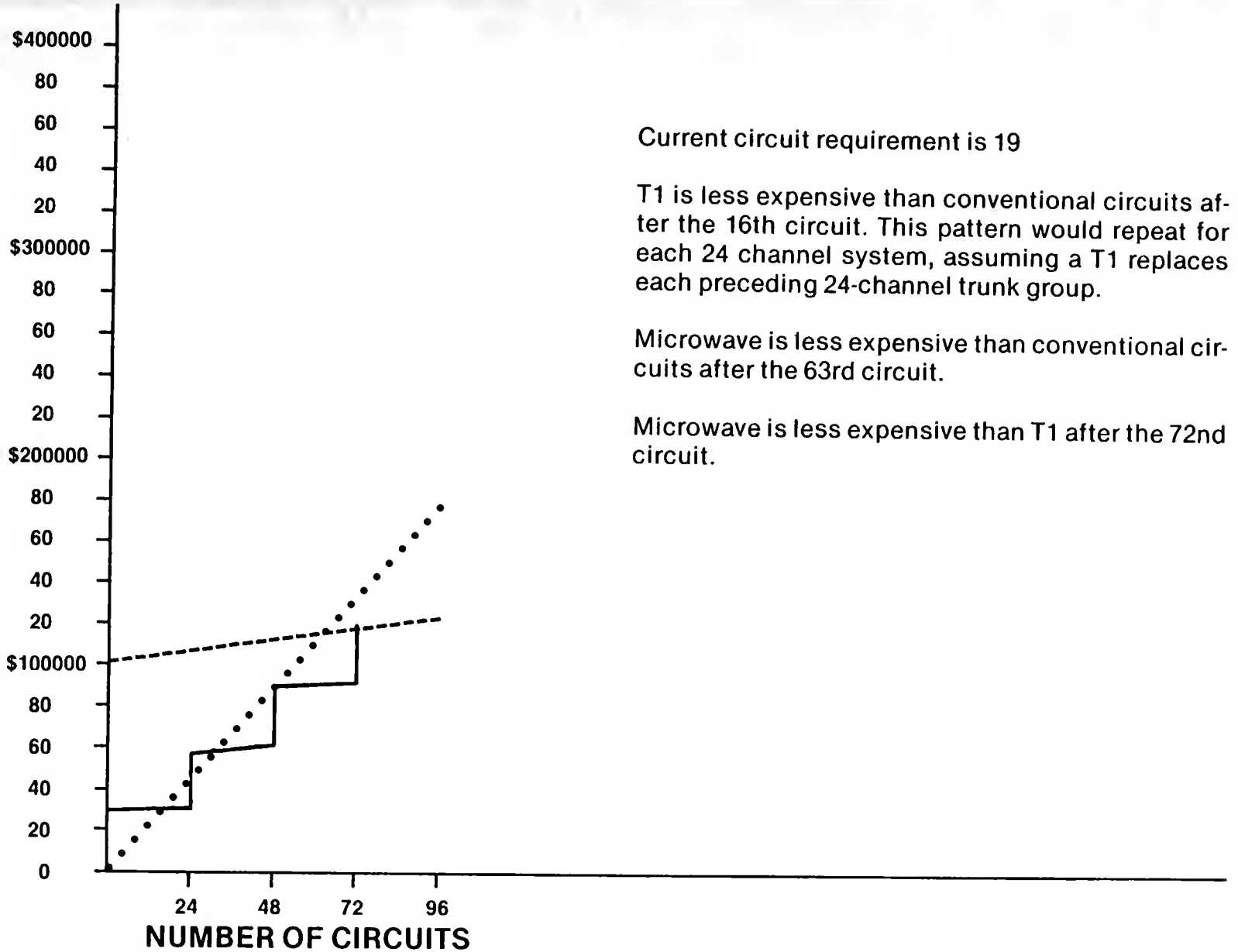
5% added to 1986 requirements to account for estimated overflow to discounted toll.

Growth estimated at approximately 2% per year.

Cost of Telco circuits increased at 7% per year.

As the circuit requirement is small, 21 circuits are used to represent the nominal requirement for the study period. Small additions or reductions would not change the results within the acceptable level of accuracy. The growth through the study period does not require additional T1 common equipment.

All but one repeater and the Butte terminal are assumed to have been installed for the Helena-Bozeman route. The costs for the equipment was reduced accordingly. A cost was added to one of the repeaters for the drop and insert capability required to add the leg to Butte from the repeater. See map.



Current circuit requirement is 19

T1 is less expensive than conventional circuits after the 16th circuit. This pattern would repeat for each 24 channel system, assuming a T1 replaces each preceding 24-channel trunk group.

Microwave is less expensive than conventional circuits after the 63rd circuit.

Microwave is less expensive than T1 after the 72nd circuit.

HELENA — BUTTE ROUTE

---------- Microwave Radio

———— T1

• • • • • • • • • Conventional Circuits

ECONOMIC SELECTION STUDY

DESCRIPTION: Helena – Butte Telecommunications Route
Conventional Circuits

PLAN 1 OF 3 SHEET 1 OF 1
PREP. BY _____ DATE _____
STUDY PERIOD 1986 – 95

	ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS: FIRST COST — Convert to Annual	CAPITAL REQUIREMENTS: PRESENT WORTH OF FIRST COST — DATE OF EXPEND.	FACTOR	AMOUNT	REVENUE REQUIREMENTS: ANNUAL COST — PER CENT	ANNUAL COST — AMOUNT	PRESENT WORTH OF ANNUAL COSTS — PERIOD	FACTOR	AMOUNT
1	Helena – Butte Ckts	21	147	X 12.564	86				38,785	10	6.144	238,295
2												
3												
4												
5	Ckt. cost Additions	21	10.29	X 12.564	87				2,715	10-1	5.235	14,213
6			11.01		88				2,905	10-2	4.408	12,805
7			11.78		89				3,108	10-3	3.657	11,366
8			12.61		90				3,327	10-4	2.974	9,894
9			13.48		91				3,557	10-5	2.353	8,370
10			14.43		92				3,807	10-6	1.789	6,811
11			15.44		93				4,074	10-7	1.276	5,198
12			16.52		94				4,359	10-8	.809	3,526
13		↓	17.68	↓	95				4,665	10-9	.385	1,796
14												
15	One time Installation Chg	6	577		86	1.0						3,462
16												
17	Total								—			315,736
18												
19												
20												

REMARKS:

	NON-STANDARD ANNUAL COST PERCENTAGES (1)	(2)	(3)	(4)	(5)
TYPE OF PLANT					
C OF M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL %					

ECONOMIC SELECTION STUDY

DESCRIPTION: Helena - Butte Telecommunications Route
Microwave Radio And T1 Channel Banks

PLAN 2 OF 3 SHEET 1 OF 3
PREP. BY _____ DATE _____
STUDY PERIOD _____

	ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS: FIRST COST AMOUNT	CAPITAL REQUIREMENTS: PRESENT WORTH OF FIRST COST DATE OF EXPEND.	CAPITAL REQUIREMENTS: PRESENT WORTH OF FIRST COST FACTOR	CAPITAL REQUIREMENTS: PRESENT WORTH OF FIRST COST AMOUNT	REVENUE REQUIREMENTS: ANNUAL COST PER CENT	REVENUE REQUIREMENTS: ANNUAL COST AMOUNT	REVENUE REQUIREMENTS: PRESENT WORTH OF ANNUAL COSTS PERIOD	REVENUE REQUIREMENTS: PRESENT WORTH OF ANNUAL COSTS FACTOR	REVENUE REQUIREMENTS: PRESENT WORTH OF ANNUAL COSTS AMOUNT
1	Channel Bank Equip	2	6000	12,000	86	1.0						
2	Channel Units	42	20	10,920	86	1.0						
3	Total			22,920				22.7	5203	10	6.144	31,966
4												
5	Microwave Radio Equip											
6	Terminal Site Complete	1	135,500	135,500	86	1.0		Pg 2	30198	10	6.144	185,537
7	Remote Repeater	1	28[illegible],400	28[illegible],400	86	1.0		Pg 2	62,383	10	6.144	383,281
8	Repeater Partial	1	73,400	73,400	86	1.0		Pg 3	16,662	10	6.144	102,372
9	Total			495,300					109,243			671,190
10												
11	Deduct for 96 ch. radios	4	9000	(36,000)	86	1.0		22.7	(8,172)	10	(.144	(50,209)
12												
13	Grand Total			482,220					106,274			652,947
14												
15												
16												
17												
18												
19												
20												

REMARKS: _____

	NON-STANDARD ANNUAL COST PERCENTAGES (1)	(2)	(3)	(4)	(5)
TYPE OF PLANT					
C OF M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL %					

ECONOMIC SELECTION STUDY

DESCRIPTION: Helena - Butte Telecommunications Route
Microwave Radio Site Unit Costs

PLAN 2 OF 3 SHEET 2 OF 3
PREP. BY _____ DATE _____
STUDY PERIOD _____

	ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS: FIRST COST AMOUNT	PRESENT WORTH OF FIRST COST: DATE OF EXPEND.	PRESENT WORTH OF FIRST COST: FACTOR	PRESENT WORTH OF FIRST COST: AMOUNT	REVENUE REQUIREMENTS: ANNUAL COST PER CENT	ANNUAL COST AMOUNT	PRESENT WORTH OF ANNUAL COSTS: PERIOD	PRESENT WORTH OF ANNUAL COSTS: FACTOR	PRESENT WORTH OF ANNUAL COSTS: AMOUNT
1	Terminal Site				86	1.0				10	6.144	
2	Digital Microwave Radio	1	54,900					22.7	12,462			75,567
3	Antenna System	1	9,000					22.7	2,043			12,552
4	Battery and Power	1	5,600					22.7	1,271			7,809
5	AC Generator	1	35,000					21.7	7,595			46,664
6	Tower, Stub, 30 Ft.	1	16,000					21.7	3,472			21,332
7	Site Work, Existing Bldg.	1 Lot	5,000					21.7	1,085			6,666
8	Spares, Each Site	1 Lot	10,000					22.7	2,270			13,947
9	Total			135,500					30,198			185,537
10												
11	Remote Repeaters				86	1.0				10	6.144	
12	Spares, Each Site	1 Lot	10,000	10,000				22.7	2,270			13,947
13	Digital Microwave Radio	2	50,400	100,800				22.7	22,882			140,587
14	Antenna System	2	9,000	18,000				22.7	4,086			25,104
15	Battery and Power	1	5,600	5,600				22.7	1,271			7,809
16	AC Generator	1	35,000	35,000				21.7	7,595			46,664
17	Tower, 150 Ft.	1	62,000	62,000				21.7	13,454			82,661
18	Land And Site Work	1	30,000	30,000				18.0	5,400			33,178
19	Building	1	25,000	25,000				21.7	5425			33,331
20	Total			286,400					62,383			383,281

REMARKS:

	NON-STANDARD ANNUAL COST PERCENTAGES (1)	(2)	(3)	(4)	(5)
TYPE OF PLANT	MW+MUX	Towers	Buildings	Land	A.C. Gen.
C OF M	10	10	10	10	10
PROPERTY TAX	0	0	0	0	0
INCOME TAX	0	0	0	0	0
DEPRECIATION	6.7	6.7	6.7	0	6.7
MAINTENANCE	6	5	5	8	5
TOTAL %	22.7	21.7	21.7	18.0	21.7

ECONOMIC SELECTION STUDY

DESCRIPTION: Helena - Butte Telecommunications Route
Microwave Radio Site Unit Costs

PLAN 2 OF 3 SHEET 3 OF 3
PREP. BY _____ DATE _____
STUDY PERIOD _____

	ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS: FIRST COST AMOUNT	CAPITAL REQUIREMENTS: PRESENT WORTH OF FIRST COST DATE OF EXPEND.	CAPITAL REQUIREMENTS: PRESENT WORTH OF FIRST COST FACTOR	CAPITAL REQUIREMENTS: PRESENT WORTH OF FIRST COST AMOUNT	REVENUE REQUIREMENTS: ANNUAL COST PER CENT	REVENUE REQUIREMENTS: ANNUAL COST AMOUNT	REVENUE REQUIREMENTS: PRESENT WORTH OF ANNUAL COSTS PERIOD	REVENUE REQUIREMENTS: PRESENT WORTH OF ANNUAL COSTS FACTOR	REVENUE REQUIREMENTS: PRESENT WORTH OF ANNUAL COSTS AMOUNT
1	Partial Repeater Site				86	1.0				10	6.144	
2	Drop + Insert Capability	In/out	14,000	14,000				22.7	3178			19,526
3	Digital Microwave Radio	1	50,400	50,400				22.7	11441			70,294
4	Antenna System	1	9000	9,000				22.7	2043			12,552
5				73,400					16,662			102,372
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												

REMARKS:

	NON-STANDARD ANNUAL COST PERCENTAGES (1)	(2)	(3)	(4)	(5)
TYPE OF PLANT					
C OF M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL %					

ECONOMIC SELECTION STUDY

DESCRIPTION: Helena - Butte Telecommunications Route
T1 Circuits

PLAN 3 OF 3 SHEET 1 OF 1
PREP. BY _____ DATE _____
STUDY PERIOD _____

	ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS: FIRST COST AMOUNT	PRESENT WORTH OF FIRST COST: DATE OF EXPEND.	PRESENT WORTH OF FIRST COST: FACTOR	PRESENT WORTH OF FIRST COST: AMOUNT	REVENUE REQUIREMENTS: ANNUAL COST PER CENT	ANNUAL COST AMOUNT	PRESENT WORTH OF ANNUAL COSTS: PERIOD	PRESENT WORTH OF ANNUAL COSTS: FACTOR	PRESENT WORTH OF ANNUAL COSTS: AMOUNT
1	Channel Bank Equip	2	6000	12,000	86	1.0						
2	Channel Units	42	260	10,920	86	1.0						
3				22,920				22.7	5,203	10	6.144	31,966
4												
5			Monthly Charge	Factor To Conv To Annual								
6	T1 Facility	1	2840	X 12.564	86				35,682	10	6.144	219,229
7	30% discount for 5								(10,705)			(65,769)
8	year contract											
9	1 Time Charge	1	2100		86	1.0						2,100
10												
11												
12	Total								30,180			187,526
13												
14												
15												
16												
17												
18												
19												
20												

REMARKS: T1 costs for facility based on 5 year contract

	NON-STANDARD ANNUAL COST PERCENTAGES (1)	(2)	(3)	(4)	(5)
TYPE OF PLANT					
C OF M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL %					

SECTION 6

HELENA-WARM SPRINGS

HELENA-DEER LODGE

TELECOMMUNICATIONS ROUTE STUDY

Helena-Warm Springs

Inspection of the Helena-Warm Springs route circuit costs reveals that the conventional circuits are priced the same as Helena-Butte circuits. The T1 circuits are slightly more expensive. The microwave route costs would be virtually the same, except for fewer channel units. This means that the cost relationship developed in the study are essentially the same for Helena-Butte and Helena-Warm Springs. Conventional circuits are more economical until the circuit requirement exceeds 16. Combining the Warm Springs and Butte circuits into a large total requirement would not be advantageous because of the significant cost to carry the circuits between Warm Springs and Butte. Combining them on microwave radio would not make the microwave radio plan cost effective because the requirements would still be lower then the prove-in point for microwave. That point would become higher in number of circuits as a result of the cost of the additional equipment required at the last repeater and the added Warm Springs terminal.

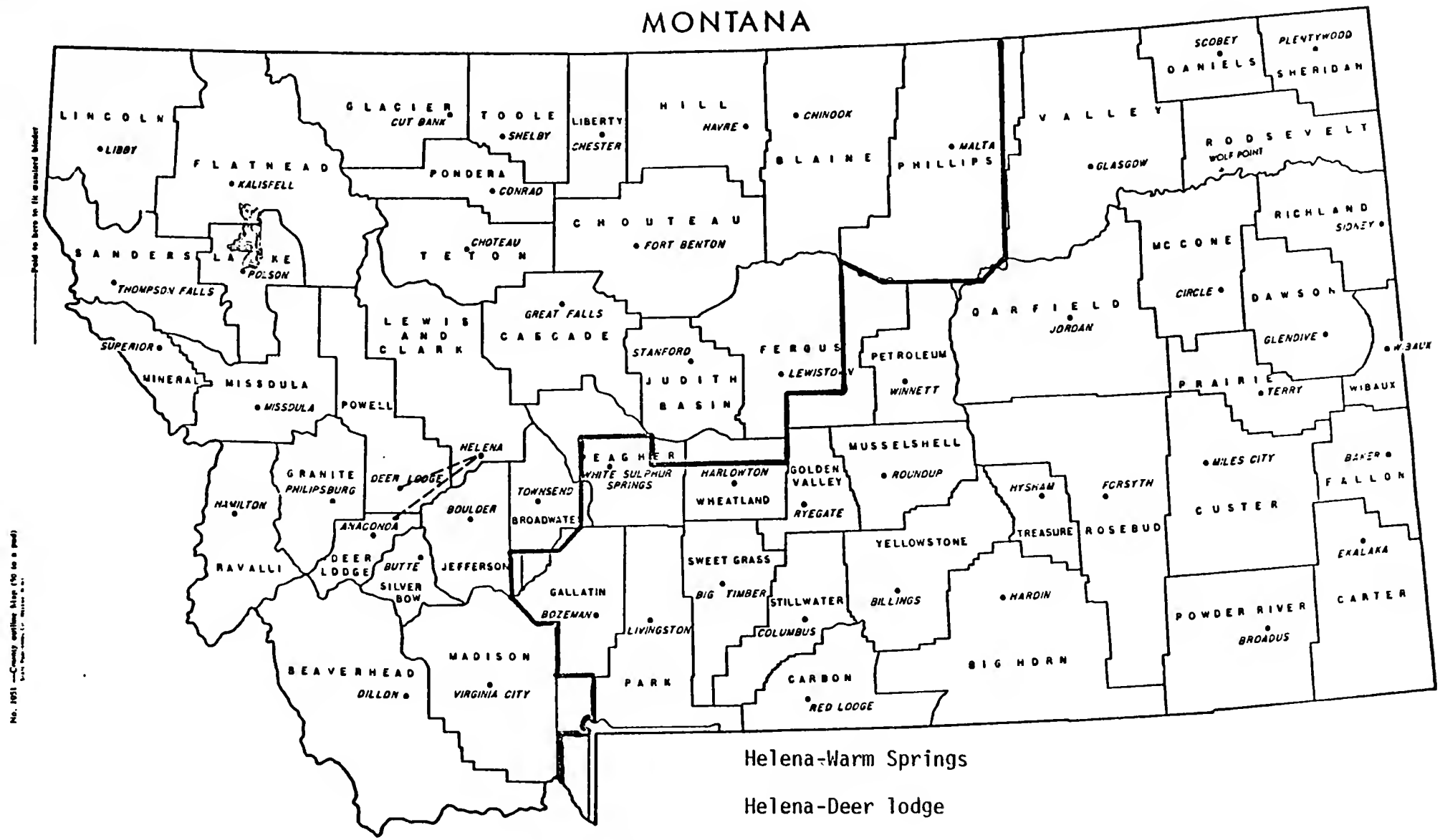
Helena-Deer Lodge

Two plans are compared in the analysis of the Helena-Deer Lodge route: conventional circuits and T1 circuits. Microwave radio is not cost effective for a cross section with circuit requirements of the size encountered on this route.

Summary of Results

	Present Worth of Annual Costs	Description
Plan 1	$ 131,658	Conventional circuits
Plan 2	162,258	T1 Circuits

The results indicate that conventional circuits are more cost effective than T1 circuits at the present rates and circuit requirements. As the circuit requirement is lower than the economical minimum for T1 or microwave radio, it is recommended that conventional circuits be retained. If a significant change in circuit costs or the number of circuits required occurs, this route should be re-examined. A requirement for 56 Kbps data would also be cause for re-examining the route. T1 would be more economical than conventional circuits after the 16th circuit.


MONTANA
LINCOLN
LIBBY
FLATHEAD
KALISPELL
GLACIER
CUT BANK
TOOLE
SHELBY
LIBERTY
CHESTER
HILL
HAVRE
CHINOOK
BLAINE
PHILLIPS
MALTA
VALLEY
GLASGOW
SCOBEY
DANIELS
PLENTYWOOD
SHERIDAN
ROOSEVELT
WOLF POINT
PONDERA
CONRAD
CHOUTEAU
FORT BENTON
TETON
CHOTEAU
SANDERS
LAKE
POLSON
THOMPSON FALLS
RICHLAND
SIDNEY
MCCONE
CIRCLE
GARFIELD
JORDAN
DAWSON
GLENDIVE
WIBAUX
PRAIRIE
TERRY
LEWIS AND CLARK
GREAT FALLS
CASCADE
STANFORD
JUDITH BASIN
FERGUS
LEWISTOWN
PETROLEUM
WINNETT
SUPERIOR
MINERAL
MISSOULA
MISSOULA
POWELL
HELENA
GRANITE
PHILIPSBURG
DEER LODGE
HAMILTON
ANACONDA
BOULDER
TOWNSEND
BROADWATER
EAGLE
WHITE SULPHUR SPRINGS
HARLOWTON
WHEATLAND
GOLDEN VALLEY
RYEGATE
MUSSELSHELL
ROUNDUP
HYSHAM
FORSYTH
MILES CITY
CUSTER
BAKER
FALLON
RAVALLI
DEER LODGE
BUTTE
SILVER BOW
JEFFERSON
GALLATIN
BOZEMAN
SWEET GRASS
BIG TIMBER
YELLOWSTONE
BILLINGS
TREASURE
ROSEBUD
EXALAKA
CARTER
STILLWATER
COLUMBUS
HARDIN
POWDER RIVER
BROADUS
BEAVERHEAD
DILLON
MADISON
VIRGINIA CITY
LIVINGSTON
PARK
CARBON
RED LODGE
BIG HORN
Helena-Warm Springs
Helena-Deer lodge
County Seat
T1 Route

HELENA-WARM SPRINGS

HELENA-DEER LODGE

CIRCUIT REQUIREMENTS

	86	88	90	92	94	96
Helena-Warm Springs, 10 voice	11	11	12	12	13	13
Helena-Deer Lodge, 7 voice, 1 data	9	9	9	10	10	11

5% added to 1986 requirements to account for estimated overflow to discounted toll.

Growth estimated at approximately 2% per year.

Cost of Telco circuits increased at 7% per year.

Since growth is small, 12 circuits are used to represent the nominal requirement for the study period for Warm Springs, and 10 circuits are used to represent the nominal requirements for Deer Lodge.

ECONOMIC SELECTION STUDY

DESCRIPTION: Helena - Deer Lodge Telecommunications Route
Conventional Circuits

PLAN 1 OF 2 SHEET 1 OF 1
PREP. BY _____ DATE _____
STUDY PERIOD _____

	ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS: FIRST COST Convert To Annual	CAPITAL REQUIREMENTS: PRESENT WORTH OF FIRST COST: DATE OF EXPEND.	FACTOR	AMOUNT	REVENUE REQUIREMENTS: ANNUAL COST: PER CENT	AMOUNT	PRESENT WORTH OF ANNUAL COSTS: PERIOD	FACTOR	AMOUNT
1	Helena - Deer Lodge	10	129	X 12.564	86				16,208	10	6.144	99,582
2	CKts											
3												
4												
5	Ckt Cost Additions	10	9.03	X 12.564	87				1135	10-1	5.235	5942
6			9.66		88				1214	10-2	4.408	5351
7			10.34		89				1299	10-3	3.657	4751
8			11.06		90				1390	10-4	2.974	4133
9			11.84		91				1488	10-5	2.353	3500
10			12.67		92				1592	10-6	1.789	2848
11			13.55		93				1702	10-7	1.276	2172
12			14.50		94				1922	10-8	.809	1474
13		↓	15.52	↓	95				1950	10-9	.385	751
14												
15	One-Time Installation Chg.	2	577		86	1.0						1154
16												
17	Total											131,658
18												
19												
20												

REMARKS:

	NON-STANDARD ANNUAL COST PERCENTAGES (1)	(2)	(3)	(4)	(5)
TYPE OF PLANT					
C OF M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL %					

ECONOMIC SELECTION STUDY

DESCRIPTION: Helena - Deer Lodge Telecommunications Route
T1 Circuits

PLAN 2 OF 2 SHEET 1 OF 1
PREP. BY _____ DATE _____
STUDY PERIOD _____

	ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS: FIRST COST AMOUNT	PRESENT WORTH OF FIRST COST: DATE OF EXPEND.	PRESENT WORTH OF FIRST COST: FACTOR	PRESENT WORTH OF FIRST COST: AMOUNT	REVENUE REQUIREMENTS: ANNUAL COST PER CENT	ANNUAL COST AMOUNT	PRESENT WORTH OF ANNUAL COSTS: PERIOD	PRESENT WORTH OF ANNUAL COSTS: FACTOR	PRESENT WORTH OF ANNUAL COSTS: AMOUNT
1	Channel Bank Equip.	2	6000	12,000	86	1.0						
2	Channel Units	20	260	5,200	86	1.0						
3				17,200				22.7	3,904	10	6.144	23,989
4												
5			Monthly Charge	Factor To Convert To Ann.								
6	T1 Facility	1	2520	x 12.564					31,661	10	6.144	194,527
7	30% discount for 5								(9,498)			(58,358)
8	year contract											
9	1 Time Charge	1	2100		86	1.0						2100
10												
11												
12	Total								26,067			162,258
13												
14												
15												
16												
17												
18												
19												
20												

REMARKS: _____

	NON-STANDARD ANNUAL COST PERCENTAGES (1)	(2)	(3)	(4)	(5)
TYPE OF PLANT					
C OF M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL %					

SECTION 7

MISSOULA-KALISPELL

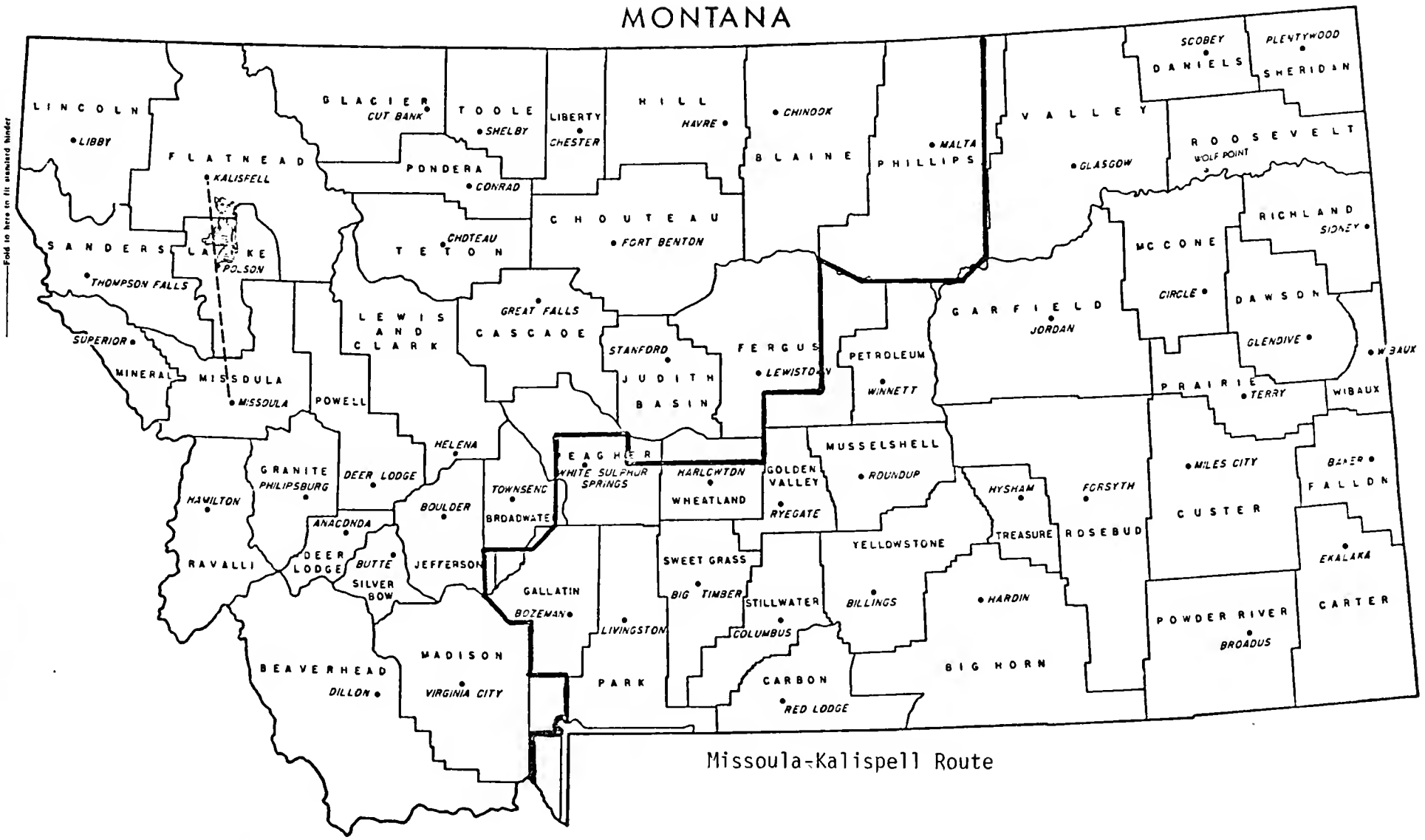
TELECOMMUNICATIONS ROUTE STUDY

Two plans are compared in the analysis of the Missoula-Kalispell route: conventional circuits and T1 circuits. Microwave radio is not cost effective for the number of circuits and the route miles involved.

Summary of Results

	Present Worth of Annual Costs	Description
Plan 1	$ 333,459	Conventional circuits
Plan 2	284,761	T1 Circuits

The results indicate that T1 circuits are more cost effective over the life of the plan. However, as the present circuit requirement has not reached the break-even point of 17 circuits, no action should be taken at present to change from conventional circuits. An overall increase in requirements, a requirement for 56 Kbps data circuits or an increase in the per-circuit costs of conventional circuits would warrant a re-examination of the route economics.


MONTANA
LINCOLN
LIBBY
FLATHEAD
KALISPELL
GLACIER
CUT BANK
TOOLE
SHELBY
LIBERTY
CHESTER
HILL
HAVRE
CHINOOK
BLAINE
MALTA
PHILLIPS
VALLEY
GLASGOW
SCOBEY
DANIELS
PLENTYWOOD
SHERIDAN
ROOSEVELT
WOLF POINT
PONDERA
CONRAD
CHOUTEAU
FORT BENTON
TETON
SANDERS
THOMPSON FALLS
LAKE
POLSON
RICHLAND
SIDNEY
MCCONE
CIRCLE
GARFIELD
JORDAN
DAWSON
GLENDIVE
WIBAUX
PRAIRIE
TERRY
SUPERIOR
MINERAL
MISSOULA
POWELL
LEWIS AND CLARK
GREAT FALLS
CASCADE
STANFORD
JUDITH BASIN
FERGUS
LEWISTOWN
PETROLEUM
WINNETT
HELENA
GRANITE
PHILIPSBURG
DEER LODGE
TOWNSEND
BROADWATER
TEAGUE
WHITE SULPHUR SPRINGS
HARLOWTON
WHEATLAND
GOLDEN VALLEY
RYEGATE
MUSSELSHELL
ROUNDUP
HYSHAM
FORSYTH
MILES CITY
CUSTER
BAKER
FALLON
HAMILTON
BOULDER
ANACONDA
DEER LODGE
BUTTE
SILVER BOW
JEFFERSON
RAVALLI
SWEET GRASS
BIG TIMBER
YELLOWSTONE
TREASURE
ROSEBUD
EKALAKA
GALLATIN
BOZEMAN
LIVINGSTON
STILLWATER
COLUMBUS
BILLINGS
HARDIN
POWDER RIVER
BROADUS
CARTER
BEAVERHEAD
DILLON
MADISON
VIRGINIA CITY
PARK
CARBON
RED LODGE
BIG HORN
Missoula-Kalispell Route
County Seat
T1 Route

MISSOULA-KALISPELL ROUTE CIRCUITS REQUIREMENTS

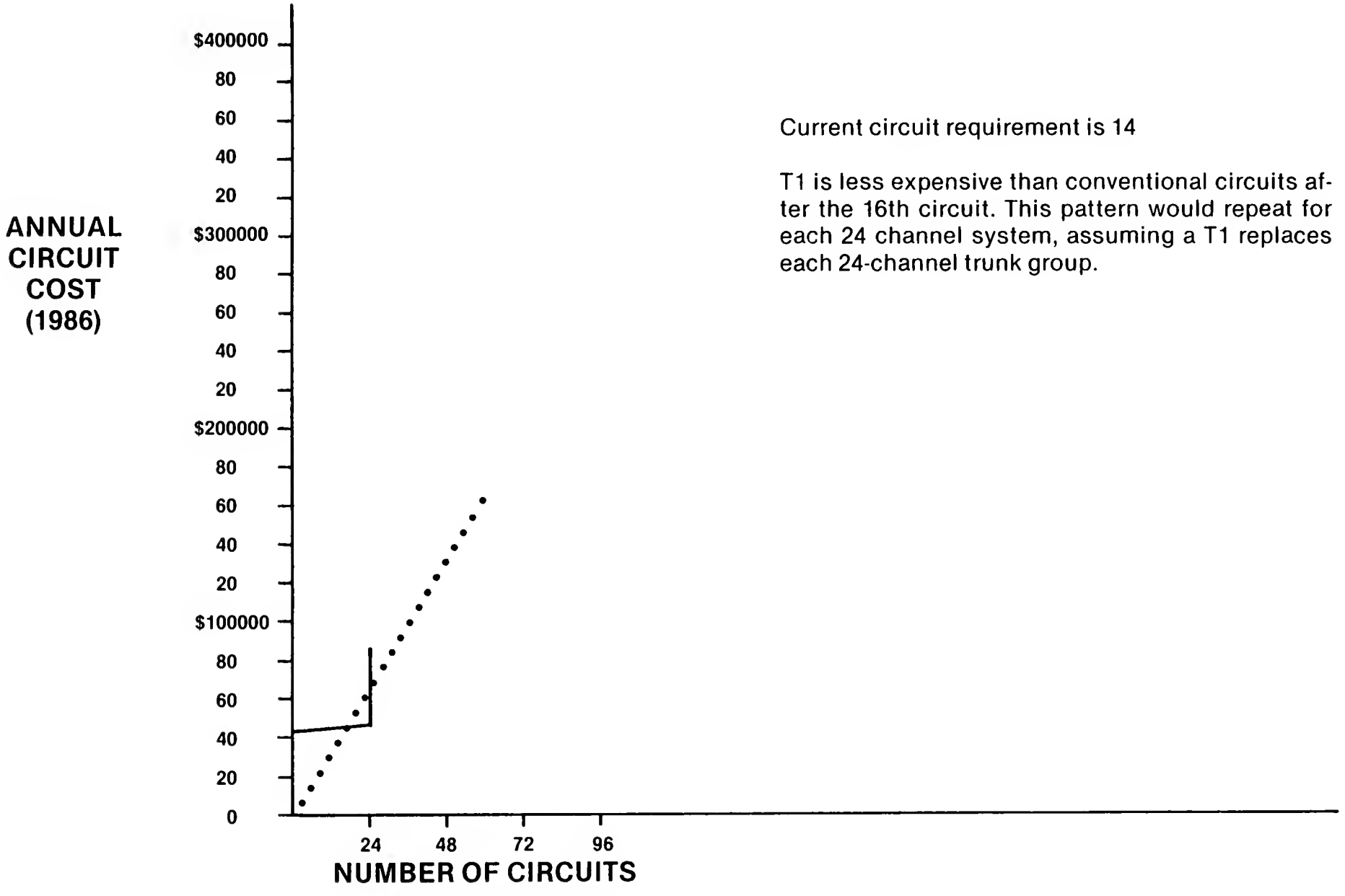
	86	88	90	92	94	96
Missoula-Kalispell, 12 voice, 1 data	14	15	15	16	17	17

5% added to 1986 requirements to account for estimated overflow to discounted toll on the present system.

Growth estimated at approximately 2% per year.

Cost of Telco circuits increased at 7% per annum.

15 circuits are used to represent the total during the study period.



Current circuit requirement is 14

T1 is less expensive than conventional circuits after the 16th circuit. This pattern would repeat for each 24 channel system, assuming a T1 replaces each 24-channel trunk group.

MISSOULA — KALISPELL ROUTE

——— **T1 Circuits**

• • • • • • • • • **Conventional Circuits**

ECONOMIC SELECTION STUDY

DESCRIPTION: Missoula - Kalispell Telecommunications Route
Conventional Circuits

PLAN 1 OF 2 SHEET 1 OF 1
PREP. BY _____ DATE _____
STUDY PERIOD _____

	ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS: FIRST COST: Convert to Annual AMOUNT	CAPITAL REQUIREMENTS: PRESENT WORTH OF FIRST COST: DATE OF EXPEND.	FACTOR	AMOUNT	REVENUE REQUIREMENTS: ANNUAL COST: PER CENT	ANNUAL COST: AMOUNT	PRESENT WORTH OF ANNUAL COSTS: PERIOD	FACTOR	AMOUNT
1	Missoula - Kalispell CKTs	15	219	X 12.564	86				41273	10	6.144	253,580
2												
3												
4												
5	Ckt Cost Additions	15	15.33	X 12.564	87				2889	10-1	5.235	15,124
6			16.40		88				3091	10-2	4.408	13,624
7			17.55		89				3307	10-3	3.657	12,095
8			18.78		90				3539	10-4	2.974	10,526
9			20.09		91				3786	10-5	2.353	8,909
10			21.50		92				4052	10-6	1.789	7,249
11			23.01		93				4336	10-7	1.276	5,533
12			24.62		94				4640	10-8	.809	3,754
13		↓	26.34	↓	95				4964	10-9	.385	1,911
14												
15	One-Time Installation Chg	2	577		86	1.0						1,154
16												
17	Total											333,469
18												
19												
20												

REMARKS: _____

	NON-STANDARD ANNUAL COST PERCENTAGES (1)	(2)	(3)	(4)	(5)
TYPE OF PLANT					
C OF M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL %					

ECONOMIC SELECTION STUDY

DESCRIPTION: Missoula - Kalispell Telecommunications Route
T1 Circuits

PLAN 2 OF 2 SHEET 1 OF 1
PREP. BY _____ DATE _____
STUDY PERIOD _____

	ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS: FIRST COST AMOUNT	PRESENT WORTH OF FIRST COST: DATE OF EXPEND.	PRESENT WORTH OF FIRST COST: FACTOR	PRESENT WORTH OF FIRST COST: AMOUNT	REVENUE REQUIREMENTS: ANNUAL COST PER CENT	ANNUAL COST AMOUNT	PRESENT WORTH OF ANNUAL COSTS: PERIOD	PRESENT WORTH OF ANNUAL COSTS: FACTOR	PRESENT WORTH OF ANNUAL COSTS: AMOUNT
1	Channel Bank Equip.	2	6000	12,000	86	1.0						
2	Channel Units	30	260	7,800	86	1.0						
3				19,800				22.7	4,495	10	6.144	27,615
4												
5			Monthly Charge	Factor To Convert To Ann.								
6	T1 Facility	1	4720	X 12.564					59,302	10	6.144	364,352
7	30% discount for 5 year								(17,791)			(109,306)
8	Contract											
9	1 Time Charge	1	2100		86	1.0						2100
10												
11												
12	Total								46,006			284,761
13												
14												
15												
16												
17												
18												
19												
20												

REMARKS: _____

	NON-STANDARD ANNUAL COST PERCENTAGES (1)	(2)	(3)	(4)	(5)
TYPE OF PLANT					
C OF M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL %					

SECTION 8

BILLINGS-MILES CITY

TELECOMMUNICATIONS ROUTE STUDY

The Billings-Miles City circuits are priced approximately the same per mile as the Missoula Kalispell circuits as follows:

	5 year T1	Conventional
Missoula-Kalispell	$34.33/month/mile	$1.60/month/mile
Billings-Miles City	$34.45/month/mile	$1.60/month/mile

Other applicable charges, such as termination and one-time charges, are also the same.

It is concluded, therefore, that the cost relationship for the Billings-Miles City circuits would be nearly identical to those for the Missoula-Kalispell circuits.

The circuit requirements for this route are 10 voice and one data circuit. Using the 5% addition factor for overflow to discounted toll and increasing at 2% per year, the requirements are as follows:

	86	88	90	92	94	96
Billings-Miles City	12	12	13	13	14	14

The cost relationship indicate that T1 circuits are more economical than conventional circuits when the requirement reaches 17. An increase in the cost of conventional circuits or in the requirements or a requirement for 56 Kbps data circuits would warrant a re-examination of the route economics.

SECTION 9

SATELLITE/EARTH STATION

TELECOMMUNICATIONS SYSTEM STUDY, 5 CITIES

A budgetary proposal was requested for a satellite system to provide the telephone and data circuits between Helena, Billings, Bozeman, Great Falls, Missoula, Kalispell, Havre and Miles City. The costs received were incremental for earth stations on a per-site basis. Budgetary transponder rental costs were also included for estimating system costs.

The plan that is analyzed includes five earth stations and transponder capacity for the traffic generated by Helena, Billings, Bozeman, Great Falls, and Missoula. The results can be compared directly with the combined terrestrial plans for these cities.

The satellite system is not economically competitive with microwave radio or T1 for the applications studied. The satellite system is approximately 12% less expensive than conventional circuits for this application.

Television broadcasting capability could be added at a relatively small cost from one of the earth stations. If this should become a firm requirement at a future date, a satellite system should be re-examined for cost effectiveness at that time.

ECONOMIC SELECTION STUDY

DESCRIPTION: Satellite / Earth Station System, 5 Cities

PLAN ___ OF ___ SHEET ___ OF ___
PREP. BY M DATE ___
STUDY PERIOD 86 - 95

	ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS: FIRST COST AMOUNT	PRESENT WORTH OF FIRST COST: DATE OF EXPEND.	FACTOR	AMOUNT	REVENUE REQUIREMENTS: ANNUAL COST PER CENT	AMOUNT	PRESENT WORTH OF ANNUAL COSTS: PERIOD	FACTOR	AMOUNT
1	Reference Station	1	550,000	550,000	86							
2	Local Stations	4	520,000	2,080,000	86							
3	Frequency Coordination	1 Lot	20,000	20,000	86							
4	and Licensing											
5	Shipping .5% estimated	1 Lot	10,500	10,500	86							
6	Site Work	4	5,000	20,000	86							
7	Total			2,680,500				22.7	608,474	10	6.144	3,738,461
8												
9												
10		Monthly	Charge	Annual Factor								
11	Annual Transponder Cost	60500	X.79	x 12.564								
12									600,496	10	6.144	3,689,450
13	Total 1											
14												7,427,911
15												
16												
17												
18												
19												
20												

REMARKS:

79% of the circuits included in the proposal are served by the 4 stations covered. The transponder cost was reduced accordingly.

Stations were included for direct comparison with the terrestrial plans

	NON-STANDARD ANNUAL COST PERCENTAGES (1)	(2)	(3)	(4)	(5)
TYPE OF PLANT	Same as	MW Radio			
C OF M					
PROPERTY TAX					
INCOME TAX					
DEPRECIATION					
MAINTENANCE					
TOTAL %					

SECTION 10

SMALL EARTH TERMINAL DATA SYSTEMS STUDY

A budgetary proposal was requested for a small earth terminal data system to serve the 56 county seats. Helena was assumed to be the location for the databases that would be accessed. Helena did not have an earth terminal, but entered the system via a leased telephone line to a master earth station, assumed for pricing purposes be located in California.

The analysis indicates that this is not a cost effective substitute for the existing data systems to the small cities. The monthly cost per terminal would be $640, if purchased, or $360, if rented. Additional services such as remote sensing, could be added at the same incremental cost if the system was in place.

If some of the emerging requirements for additional data services develop, this approach should be examined for cost effectiveness and survivability. Examples of new services that might become requirements in the future are access to brands registration information, access to library material, access to land title information, access to location files, transmitting engineering information between a remote construction site and a State headquarters or any low volume, wide-spread requirement for inquiry/response transaction networking.

ECONOMIC SELECTION STUDY

DESCRIPTION: Small Earth Terminal Data System

PLAN ___ OF ___ SHEET ___ OF ___
PREP. BY M DATE ___
STUDY PERIOD 86 thru 95

	ITEM	QUANTITY	UNIT COST	CAPITAL REQUIREMENTS: FIRST COST AMOUNT	PRESENT WORTH OF FIRST COST: DATE OF EXPEND.	FACTOR	AMOUNT	REVENUE REQUIREMENTS: ANNUAL COST PER CENT	ANNUAL COST AMOUNT	PRESENT WORTH OF ANNUAL COSTS: PERIOD	FACTOR	AMOUNT
1	Earth Terminal Installed	55	9885	521,675				16.7	87,120	10	6.144	535,264
2												
3												
4			Monthly charge	Convert To Annual								
5	Micro Earth Station											
6	Connection Fee	55	35	x 12.564								
7	Maintenance and Spares	55	74	x 12.564					24,186	10	6.144	148,594
8									51,135	10	6.144	314,173
9												
10												
11	Space Segment											
12	9.6 Kbps inbound	1	2000	x 12.564								
13	19.2 Kbps outbound	1		x 12.564					25,128	10	6.144	154,386
14									251,280	10	6.144	1,543,864
15												
16	Leased Line Helena —	1	903	x 12.564								
17	Equatorial Earth Station								11,345	10	6.144	69,705
18	Installation	1	850									850
19												
20	Total								450,194			2,766,841

REMARKS: Annual
Cost per station = $450,194/56 = $8039

Monthly cost per station = $640

Initial deployment rental option = $360/month

NON-STANDARD ANNUAL COST PERCENTAGES

	(1)	(2)	(3)	(4)	(5)
TYPE OF PLANT					
C OF M	10.0				
PROPERTY TAX					
INCOME TAX					
DEPRECIATION	6.7				
MAINTENANCE	included in contract				
TOTAL %	16.7				

SECTION 11

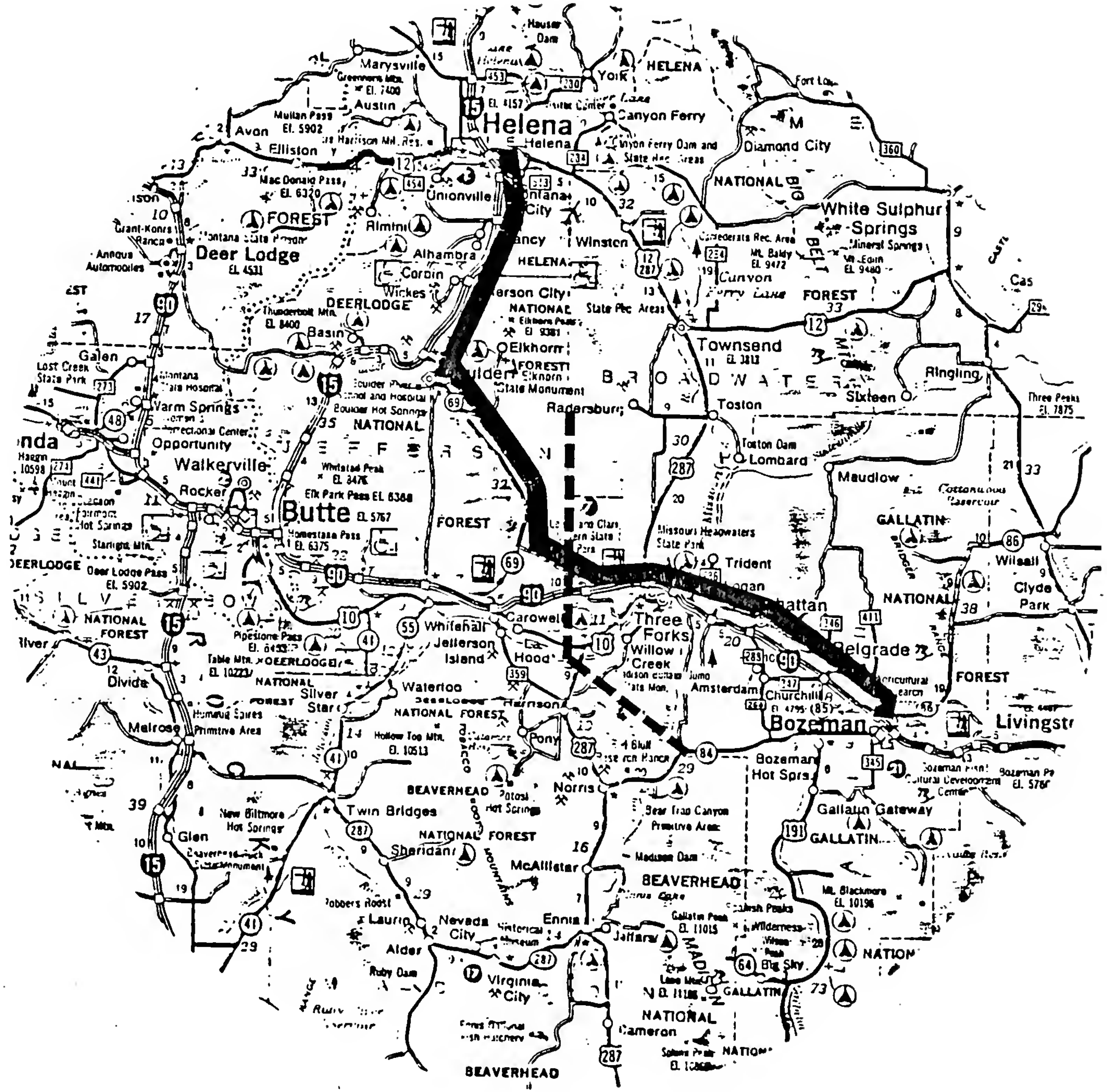
FIBER OPTIC ROUTE STUDY

A preliminary cost estimate of a fiber optic system with T1 channel banks was prepared for comparison with the costs of a microwave radio system in the same route. Helena-Bozeman was chosen for the estimate because it has the largest cross section circuit requirement, and therefore fiber optics were most likely to prove in.

The length of the route is approximately 95 miles. It was assumed that right-of-way would be available at no cost along State-owned or -controlled roads.

The total turnkey cost for this route is $2,362,645. This compares with a microwave radio system of the same installed channel capacity, whose first cost is $1,218,400.

The fiber optic system can be expanded to 15,000 voice circuits, while the microwave radio system described can be expanded to 192 channels. The fiber optic is cost effective for extremely large circuit requirements or, more accurately, bandwidth requirements, as it can support voice, data, television, or any application that can be converted to light pulses. In particular, the installed cost per circuit of the fully loaded microwave radio system would be $6,346. The installed cost per circuit of the fiber optic system, when used to support 192 channels, would be $13,727. However, when fully allocated, the fiber optic system would cost only $157.50 per installed channel. The breakeven point between fiber optics and microwave occurs at approximately 372 channels.



FIBER OPTIC ROUTE

LATA BOUNDARY

HELENA-BOZEMAN FIBER OPTIC CABLE

MONTANA DIGITAL NETWORK

HELENA-BOZEMAN OPTICAL FIBER

ROUTE LENGTH - 95 MILES - 152,888 METERS - 501,600 FEET

6 OPTICAL FIBERS - 3 PAIRS

PRESENT MAXIMUM CAPACITY - 1000 MBPS - 15,000 VOICE CIRCUITS

	COSTS
	$ NC
RIGHT OF WAY	
ROUTE ENGINEERING - $.18 x 501,600 FT	90,288
CABLE - $3.06/METER x 152,888 METERS	467,837
SPLICING AND SUPPLIES	292,600
CONSTRUCTION - 501,600 FT x $2.00/FT	1,003,200
OPTICAL SYSTEM - 2 TERMINALS	75,000
MULDEMS	23,000
THROUGH REPEATERS - 3	99,500
SUPPORT EQUIPMENT	50,000
OPTICAL SYSTEM INSTALLATION AND TEST	64,000
CHANNEL BANKS - 4 - 1.544 MBIT CAPACITY EACH	64,360
CHANNEL BANKS INSTALLATION AND TEST	12,860
SUPPORT STRUCTURES	120,000
TOTAL	$2,362,645

APPENDIX D

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APPENDIX E

GLOSSARY

GLOSSARY

A

A/D	Analog to Digital (conversion)
ADPCM	Adaptive Differential Pulse-Code Modulation
ATT COM	AT&T Communications, formerly Long Lines
ATT IS	AT&T Information Systems, a provider of customer premises equipment

B

BER	Bit Error Rate
Bit	Basic unit of digital information

C

CAD/CAM	Computer Aided Drafting/Computer Aided Mapping
CATV	Cable Television
C-Band	4/6 GHz Frequency Band used for Satellite Communications
CCR	Customer Controlled Reconfiguration
CO	Central Office - Switch Center
Channel Banks	Common equipment and individual channel electronic cards used to impress multiple circuit on a transmission facility. See Multiplex.
COAX	Coaxial Cable
CODEC	Coder/Decoder

Conventional Circuit	Private line single voice or data circuit provided by a common carrier.
CPE	Customer Premises Equipment
CSU	Channel Service Unit
CVSD	Continuously Variable Slope Delta Modulation

D

D/A	Digital to Analog (conversion)
dB	Decibel, unit of relative sound magnitude
DDD	Direct Distance Dialing
DEMUX	Demultiplexer
DSO	Voice Channel or 56 kbps Data Channel
DS-1, DS-2, DS-3 & DS-4	Frame and Signal Specification for Digital Transmission at 1.544, 6.312, 44.736, and 274.176 Mbps, respectively
DSU	Data Service Unit
DSX-1	T1 Channel Quality Specification; Pulse Template
DTE	Data Terminal Equipment
DTS	Digital Termination Service
DTMF	Dual Tone Multi-frequency
D1, D1D, D2, D3 & D4	Channel Banks for T1 Communications

E

ESS	Electronic Switching System

F

FAX	Facsimile
FCC	Federal Communications Commission
FDM	Frequency Division Multiplex
F/O	Fiber Optics, a transmission medium using light to transmit digital signals
FT2, FT3, & FT4	Fiber Optic T-Channel Equivalent Systems (12.624, 44.736, and 274,176 Mbps)

G

G&A	General and Administrative Expenses
Gbps	Gigabits per second, bits X 10(9)
GHz	Gigahertz, billions of cycles per second

H

HF	High Frequency
Hz	Hertz, formerly Cycles Per Second

I

ISDN	Integrated Services Digital Network

K

Kbps	Kilobits Per Second, 1000 bits/second
km	Kilometer

Ku-Band	11/14 GHz Frequency Band used for Satellite communications
$K	Thousands of Dollars

L

LAN	Local Area Network
LATA	Local Access and Transport Area
LNA	Low Noise Amplifier
LRCC	Local Rate Center Connection
LSI	Large Scale Integration

M

m	Meter
Mbps	Megabits per Second 1 million bit/second
Mhz	Megahertz, millions of cycles per second
Microwave Radio	A transmission system utilizing radios of 2 GHz and higher frequency to provide a carrier for communications circuits
MODEM	Modulator/Demodulator
MUX	Multiplexer. An electronic device for establishing structured divisions of a carrier facility so that multiple circuits can be carried simultaneously. May refer to multiple systems, rather than multiple individual circuits.
M24	AT&T Channel Banks - 24 Voice/Data Channels
M44	AT&T Channel Banks - 44 Voice Channels

N

N/A	Not Available or Not Applicable

O

OCC	Other Common Carrier
OCU	Office Channel Unit

P

PBX, PBX	Private (Automatic) Branch Exchange
PCM	Pulse Code Modulation

R

RBOC	Regional Bell Operating Company
ROW	Right of Way

S

SCPC	Single Channel Per Carrier

T

TDM	Time Division Multiplex
TDMA	Time Division Multiple Access
T1, T1C,	North American STandard Digital Transmission Formats
T2, T3 & T4	(1.544, 3.152, 6.312, 44.736, and 274.176 Mbps)

U

UHF	Ultra High Frequency

V

VF	Voice Frequency
VHF	Very High Frequency